Proposed Stormwater and Sewer Infrastructure for the Umhlanga Ridgeside Development in Umhlanga Ridge, KwaZulu-Natal

Basic Assessment Report

(Draft)

November 2018

Prepared for: Tongaat Hulett Developments

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Title and Approval Page

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Amendments Page

Date:	Nature of Amendment	Amendment Number:
02/11/2018	Draft BAR for Client Review	00
14/11/2018	Draft BAR for Public and Authority Review	01

Executive Summary

INTRODUCTION

In 2007, the Umhlanga Ridgeside Development received Environmental Authorisation (EA) for a mixed land use development from the KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs (KZN EDTEA). The approved development consists of residential, commercial and open space development. This development also includes the construction of internal services such as sewage, water and electricity, the construction of stormwater management services, the construction of new roads and intersection, as well as the upgrading of existing roads and intersection. The original EA in 2007 covered the provision of sanitation services but this entailed a sewer pump station in the south eastern corner of Precinct 4. The eThekwini Metropolitan Municipality (EMM) Water and Sanitation Department have since requested Tongaat Hulett to consider a sewer system that gravitates to the existing Armstrong pump station instead, and thus reduce the number of pump stations in the greater area. The stormwater management plan, approved by eThekwini Metropolitan Municipality (EMM) in 2009 for the Umhlanga Ridgeside Development, included a Stormwater Management Strategy Plan which showed the stormwater connections/routes for the attenuated flows from the Umhlanga Ridgeside Development through the strip of the forest to the existing stormwater reticulation along the M4 motorway. However, details of these connections/routes were not clearly defined and thus were not included as part of the 2007 EA. Hence, this report focuses on the proposed stormwater and sewer infrastructure required to service the developments in these areas.

Precinct 2 of the Umhlanga Ridgeside Development can be divided into the upper and lower halves. The upper half of the Umhlanga Ridgeside Precinct 2 drains into the existing 750mm diameter bulk sewer main, which reticulates in a northerly direction to the Umhlanga Manors. Sewer reticulation services need to be provided to service the lower portion of Precinct 2 and Precinct 4 of the Umhlanga Ridgeside Development. The sewer infrastructure is proposed to feed into the existing Armstrong Avenue pump station. Three alternative options were considered for the sewer infrastructure.

Stormwater runoff needs to be managed between the Umhlanga Ridgeside Development and the M4 motorway, through the strip of forest, in order to ensure protection of the forest from siltation and pollutants, but to also ensure that the forest is not starved from runoff. Three alternative options were considered for the stormwater infrastructure.

PROJECT LOCATION

The proposed stormwater and sewer infrastructure for the Umhlanga Ridgeside Development is situated in the jurisdiction of the EMM, within the KwaZulu-Natal Province. The main built-

up areas surrounding the proposed development includes Umhlanga Rocks, La Lucia, Mount Edgecombe and Somerset Park.

Locality Map

LEGISLATION AND GUIDELINES CONSIDERED

The pertinent environmental legislation that has bearing on the proposed development is considered in the Basic Assessment Report (BAR). The project requires authorisation in terms of the National Environmental Management Act (Act No. 107 of 1998) (NEMA), and the Basic Assessment (BA) Process was undertaken in accordance with the 2014 Environmental Impact Assessment (EIA) Regulations (as amended on 07 April 2017). A description of the policy and legislative context within which the development is proposed includes an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process.

BASIC ASSESSMENT PROCESS

The proposed stormwater and sewer infrastructure entails certain activities that require authorisation in terms of NEMA. The process for seeking authorisation is undertaken in accordance with the EIA Regulations (Government Notice No. R. 982, R. 983, R. 984 and R. 985 of 04 December 2014, as amended), promulgated in terms of Chapter 5 NEMA.

Based on the types of activities involved which include activities listed in Government Notice No. R. 985 of 04 December 2014, as amended; the requisite environmental assessment for the project is a BA Process.

PUBLIC PARTICIPATION

The BAR provides a full account of the public participation process that is being followed for the proposed project. The public review period of the Draft BAR will take place for a 30-Day review period from 14 November 2018 - 14 December 2018. All authorities and registered Interested and Affected Parties (IAPs) will be notified after having received written notice from KZN EDTEA on the final decision for the project. An advertisement will also be placed as notification of the Department's decision. These notifications will include the appeal procedure to the decision and key reasons for the decision.

ENVIRONMENTAL ATTRIBUTES

The environmental attributes associated with the alternative pipeline routes identified focusing on the geographical, physical, biological, social, economic and cultural aspects of the environment. The following significant environmental attributes are focused on in this report:

1. Geology;
2. Terrestrial Ecology;
3. Air Quality;
4. Noise;
5. Aesthetic Qualities;
6. Socio – Economic Environment;
7. Transportation;
8. Existing Infrastructure;
9. Historical and Cultural Features; and
10. Watercourses.

SPECIALIST STUDIES

The following Specialist Studies undertaken as part of the BA Process, include:

1. Terrestrial Ecological Impact Assessment;
2. Phase 1 Heritage Impact Assessment; and
3. Wetland Delineation Impact Assessment.

Summaries of these specialist studies are included in the BAR.

IMPACT ASSESSMENT

The BAR focuses on the pertinent environmental impacts that could potentially be caused by the proposed project during the pre-construction, construction and operational phases of the project.

Impacts were identified as follows:

- Impacts associated with Listed Activities contained in Government Notice No. R. 983, R. 984 and R. 985 of the 2014 EIA Regulations (as amended on 07 April 2017), for which authorisation has been applied for;
- An appraisal of the project activities and components;

- Issues highlighted by environmental authorities;
- Comments received during public participation;
- An assessment of the receiving biophysical, social, economic and technical environment; and
- Findings from Specialist Studies.

The impacts and the proposed management measures are discussed on a qualitative level and thereafter quantitatively assessed by evaluating the nature, extent, magnitude, duration, probability and ultimately the significance of the impacts. The assessment considered impacts before and after mitigation, where in the latter instance the residual impact following the application of the mitigation measures is evaluated.

The proposed mitigation of the impacts associated with the project includes specific measures identified by the technical team (including engineering solutions) and environmental specialists, stipulations of environmental authorities and environmental best practices. The Environmental Management Programme (EMPr) provides a comprehensive list of mitigation measures for specific elements of the project, which extends beyond the impacts evaluated in the body of the BAR. Cumulative impacts are discussed in relation to the proposed project.

ANALYSIS OF ALTERNATIVES

The BAR provides an appraisal of all the environmental and technical considerations associated with the various alternatives through a comparative analysis to eventually distil the Best Practicable Environmental Option (BPEO). Implications of the “no-go” option are also assessed. Based on the recommendations of the specialists, technical considerations and the comparison of the impacts, the Sewer Alternative 3 and Stormwater Alternative 1 were identified as the BPEO.

CONCLUSIONS AND RECOMMENDATIONS

Attention is drawn to specific sensitive environmental features (with an accompanying sensitivity map) for which mitigation measures are included in the BAR and EMPr. An Environmental Impact Statement is provided and critical environmental activities that need to be executed during the project lifecycle are also presented. With the selection of the BPEO, the adoption of the mitigation measures included in this report, and the dedicated implementation of the EMPr, it is believed that the significant environmental aspects and impact associated with this project can be suitably mitigated. The BAR is concluded with key recommendations, which may also influence the conditions of the EA (if granted).

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List of Abbreviations

BA	Basic Assessment
BAR	Basic Assessment Report
BPEO	Best Practicable Environmental Option
CBA	Critical Biodiversity Area
CLO	Community Liaison Officer
D'MOSS	Durban Metropolitan Open Space System
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
EDTEA	Department of Economic Development, Tourism and Environmental Affairs
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EKZNW	Ezemvelo KZN Wildlife
EMM	eThekwini Metropolitan Municipality
EMPr	Environmental Management Programme
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Area
GA	General Authorisation
GN	Government Notice
IAPs	Interested and Affected Parties
KZN	KwaZulu-Natal
KZN Amafa	KwaZulu-Natal provincial heritage conservation agency
NEMA	National Environmental Management Act (No. 107 of 1998)
NWA	National Water Act (No. 36 of 1998)
OHS	Occupational Health and Safety
PES	Present Ecological State
SAHRA	South African Heritage Resources Authority
WMA	Water Management Area
WULA	Water Use License Application
WUL	Water Use License

1 DOCUMENT ROADMAP

This document serves as the Draft Basic Assessment Report (BAR) for the proposed stormwater and sewer infrastructure for the Umhlanga Ridgeside Development, KwaZulu-Natal (KZN) Province. In order to provide clarity to the reader, a document roadmap is provided in **Table 1** below. The document roadmap provides information on the requirements of the 2014 Environmental Impact Assessment (EIA) Regulations, as amended (07 April 2017), as stipulated in Appendix 1 of Government Notice (GN) No. R. 982, as promulgated in terms of the National Environmental Management Act (Act No. 107 of 1998) ("NEMA") as well as a guide on the content of each chapter. Please note that in some cases more information is provided than required in the EIA Regulations in which case there will be no correlating section to these EIA Regulations.

Table 1: Document Roadmap

Chapter	Title	Correlation with GN No. 982 – Appendix 1	
1.	**Document Roadmap**	–	–
2.	**Purpose of the Document**	–	–
3.	**Environmental Assessment Practitioner**	3(1)(a)	Details of – (i) the EAP who prepared the report; and (ii) the expertise of that EAP, including a curriculum vitae.
4.	**Project Overview**	3(1)(b)	The location of the activity, including: (i) the 21 digit Surveyor General code of each cadastral land parcel; (ii) where available, the physical address and farm name; (iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;
		3(1)(c)	A plan which locates the proposed activity or activities applied for as well as associated structures and infrastructure at an appropriate scale; or, if it is- (i) a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or (ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken;
		3(1)(d)	A description of the scope of the proposed activity, including (i) all listed and specified activities triggered and being applied for; and (ii) a description of the activities to be undertaken including associated structures and infrastructure;

Chapter	Title	Correlation with GN No. 982 – Appendix 1	
5.	**Project Alternatives**	3(1)(h)	A full description of the process followed to reach the proposed preferred alternative within the site, including: (i) details of the alternatives considered
6.	**Legislation and Guidelines Considered**	3(1)(e)	A description of the policy and legislative context within which the development is proposed including- (i) an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks, and instruments that are applicable to this activity and have been considered in the preparation of the report; and (ii) how the proposed activity complies with and responds to the legislation and policy context, plans, guidelines, tools frameworks, and instruments;
7.	**Basic Assessment Process**	–	–
8.	**Assumptions and Limitations**	3(1)(o)	A description of any assumptions, uncertainties, and gaps in knowledge which relate to the assessment and mitigation measures proposed;
9.	**Need and Desirability**	3(1)(f)	A motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location;
10.	**Timeframes**	3(1)(q)	Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required, the date on which the activity will be concluded, and the post construction monitoring requirements finalised;
11.	**Financial Provisions**	3(1)(s)	Where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts;
12.	**Public Participation Process**	3(1)(h)	A full description of the process followed to reach the proposed preferred alternative within the site, including: (ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; (iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;
13.	**Environmental Attributes**	3(1)(h)	A full description of the process followed to reach the proposed preferred alternative within the site, including: (iv) the environmental attributes associated with the alternatives focusing on the geographical, physical,

Chapter	Title	Correlation with GN No. 982 – Appendix 1	
			biological, social, economic, heritage and cultural aspects;
14.	**Summary of Specialist Studies**	3(1)(k)	Where applicable, a summary of the findings and impact management measures identified in any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final report;
		3(1)(m)	Based on the assessment, and where applicable, impact management measures from specialist reports, the recording of the proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr;
15.	**Impact Assessment**	3(1)	(h) a full description of the process followed to reach the proposed preferred alternative within the site, including: (v) the impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts- (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated; (vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives; (vii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; (viii) the possible mitigation measures that could be applied and level of residual risk; (ix) the outcome of the site selection matrix; (x) if no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and (xi) a concluding statement indicating the preferred alternatives, including preferred location of the activity;
16.	**Impact Management**		(i) a full description of the process undertaken to identify, assess and rank the impacts the activity will impose on the preferred location through the life of the activity, including- (i) a description of all environmental issues and risks that were identified during the environmental impact assessment process; and (ii) an assessment of the significance of each issue and risk and an indication of the extent

Chapter	Title	Correlation with GN No. 982 – Appendix 1	
			to which the issue and risk could be avoided or addressed by the adoption of mitigation measures; (j) an assessment of each identified potentially significant impact and risk, including- (i) cumulative impacts; (ii) the nature, significance and consequences of the impact and risk; (iii) the extent and duration of the impact and risk; (iv) the probability of the impact and risk occurring; (v) the degree to which the impact and risk can be reversed; (vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and (vii) the degree to which the impact and risk can be avoided, managed or mitigated;
17.	**Conclusions and Recommendations**	3(1)(g)	(g) a motivation for the preferred site, activity and technology alternative;
		3(1)(k)	Where applicable, a summary of the findings and impact management measures identified in any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final report;
		3(1)(l)	An environmental impact statement which contains- (i) a summary of the key findings of the environmental impact assessment; (ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and (iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;
		3(1)(m)	Based on the assessment, and where applicable, impact management measures from specialist reports, the recording of the proposed impact management outcomes for the development for inclusion in the EMPr;
		3(1)(n)	Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;
		3(1)(p)	A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;
18.	**Oath of Environmental Assessment Practitioner**	3(1)(r)	An undertaking under oath or affirmation by the EAP in relation to: (i) the correctness of the information provided in the reports;

Chapter	Title	Correlation with GN No. 982 – Appendix 1	
			(ii) the inclusion of comments and inputs from stakeholders and I&APs; (iii) the inclusion of inputs and recommendations from the specialist reports where relevant; and (iv) any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected parties;
N/A		3(1)(t)	Where applicable, any specific information required by the Competent Authority.
N/A		3(1)(u)	Any other matters required in terms of sections 24(4)(a) and (b) of the Act.

The following is included in the Appendices to meet the requirements of the 2014 EIA Regulations, as amended:

Appendix	Title	Correlation with GN No. R. 982
6	**Specialist Studies**	Appendix 6
7	**Environmental Management Programme (EMPr)**	Appendix 4

2 PURPOSE OF THE DOCUMENT

According to GN No. R. 982 of the 2014 EIA Regulations, as amended (07 April 2017), the objective of the Basic Assessment (BA) Process is, through a consultative process, to:

(a) determine the policy and legislative context within which the proposed activity is located and how the activity complies with and responds to the policy and legislative context;
(b) identify the alternatives considered, including the activity, location, and technology alternatives;
(c) describe the need and desirability of the proposed alternatives;
(d) through the undertaking of an impact and risk assessment process, inclusive of cumulative impacts which focused on determining the geographical, physical, biological, social, economic, heritage, and cultural sensitivity of the sites and locations within sites and the risk of impact of the proposed activity and technology alternatives on these aspects to determine−
    (i) the nature, significance, consequence, extent, duration, and probability of the impacts occurring to; and
    (ii) the degree to which these impacts−
        (aa) can be reversed;
        (bb) may cause irreplaceable loss of resources; and
        (cc) can be avoided, managed or mitigated; and

(e) through a ranking of the site sensitivities and possible impacts the activity and technology alternatives will impose on the sites and location identified through the life of the activity to−

(i) identify and motivate a preferred site, activity and technology alternative;

(ii) identify suitable measures to avoid, manage or mitigate identified impacts; and

(iii) identify residual risks that need to be managed and monitored.

The Draft BAR will be made available to Interested and Affected Parties (IAPs) for a 30-Day Review Period from **14 November 2018** - **14 December 2018**. All comments that are received will be assessed in the Final BAR and will also be included in the Comments and Response Report (CRR). The Final BAR will then be submitted to the KZN Department of Economic Development, Tourism and Environmental Affairs (EDTEA), the Competent Authority in respect to this proposed development.

3 ENVIRONMENTAL ASSESSMENT PRACTITIONER

Nemai Consulting was appointed by Tongaat Hulett Developments as the Independent Environmental Assessment Practitioner (EAP) to undertake the BA Process for the proposed stormwater and sewer infrastructure for the Umhlanga Ridgeside Development. In accordance with Section 3(1)(a) of Appendix 1 of GN No. R. 982 of the 2014 EIA Regulations (as amended), this section provides an overview of Nemai Consulting and the company's experience with EIAs, as well as the details and experience of the EAPs that form part of the BA team.

Nemai Consulting is an independent, specialist environmental, social development and Occupational Health and Safety (OHS) consultancy, which was founded in December 1999. The company is directed by a team of experienced and capable environmental engineers, scientists, ecologists, sociologists, economists and analysts. The core members of Nemai Consulting that are involved in the BA Process for the proposed project are captured in **Table 2** below, and their respective Curricula Vitae are contained in **Appendix 1**.

Table 2: BA core team members

Name	Qualification	Responsibility
Mr. C Chidley	BSc Eng (Civil) BA Economics MBA	Environmental Engineer
Ms K. Robertson	MSc (Environmental Sciences)	Project Manager
Mr C. Van Der Hoven	BSc Hons (Environmental Sciences)	EAP

4 PROJECT OVERVIEW

4.1 Project Background and Motivation

In 2007, the Umhlanga Ridgeside Development received Environmental Authorisation (EA) for a mixed land use development from KZN EDTEA (refer to a copy of the decision in **Appendix 2**). There were subsequently two amendments to the EA in 2008 and 2009 which can also be referred to in **Appendix 2**. The approved development consists of residential, commercial and open space development. This development also includes the construction of internal services such as sewage, water and electricity, the construction of stormwater management services, the construction of new roads and intersection, as well as the upgrading of existing roads and intersection. Refer to **Figure 1** for the approved Umhlanga Ridgeside Development.

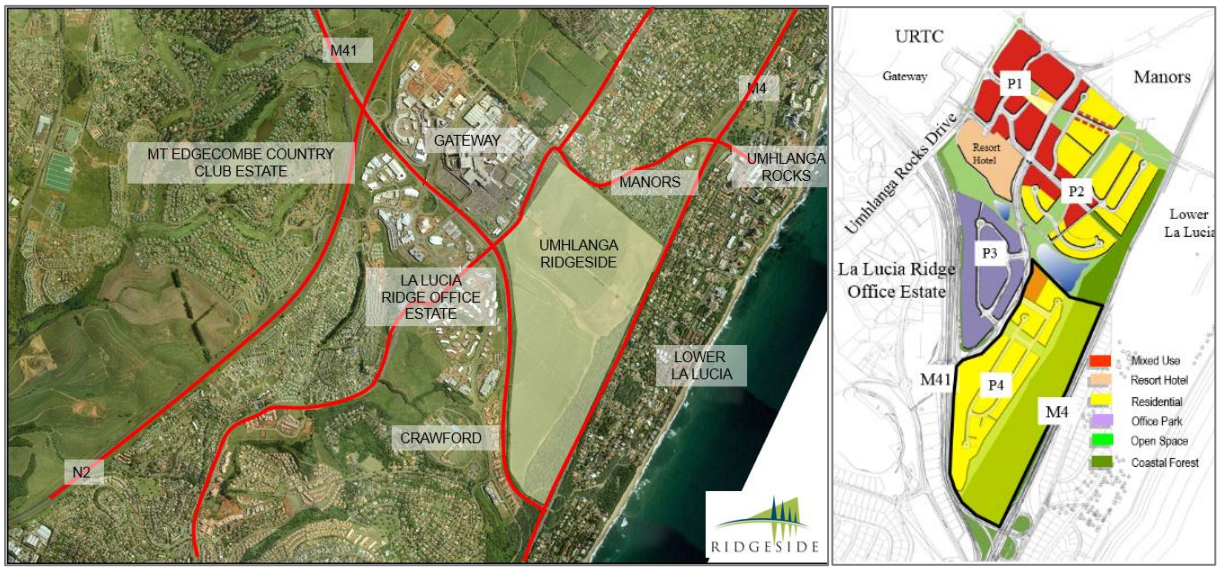


Figure 1: Approved Umhlanga Ridgeside Development

The original EA in 2007 covered the provision of sanitation services but this entailed a sewer pump station in the south eastern corner of Precinct 4. The eThekwini Metropolitan Municipality (EMM) Water and Sanitation Department have since requested Tongaat Hulett to consider a sewer system that gravitates to the existing Armstrong pump station instead, and thus reduce the number of pump stations in the greater area.

The stormwater management plan, approved by EMM in 2009 for the Umhlanga Ridgeside Development, included a Stormwater Management Strategy Plan (**Figure 2**) which showed the stormwater connections/routes for the attenuated flows from the Umhlanga Ridgeside Development through the strip of the forest to the existing stormwater reticulation along the M4 motorway. However, details of these connections/routes were not clearly defined and thus were not included as part of the 2007 EA.

Figure 2: Stormwater Management Strategy Plan approved in 2009

Hence, the BAR focuses on the proposed stormwater and sewer infrastructure required to service the developments in these areas.

4.2 Project Location

The proposed stormwater and sewer infrastructure for the Umhlanga Ridgeside Development is situated in the jurisdiction of the EMM, within the KwaZulu-Natal Province (**Figure 3**). The main built-up areas surrounding the proposed development includes Umhlanga Rocks, La Lucia, Mount Edgecombe and Somerset Park (**Figure 4**). Refer to **Appendix 3** for maps.

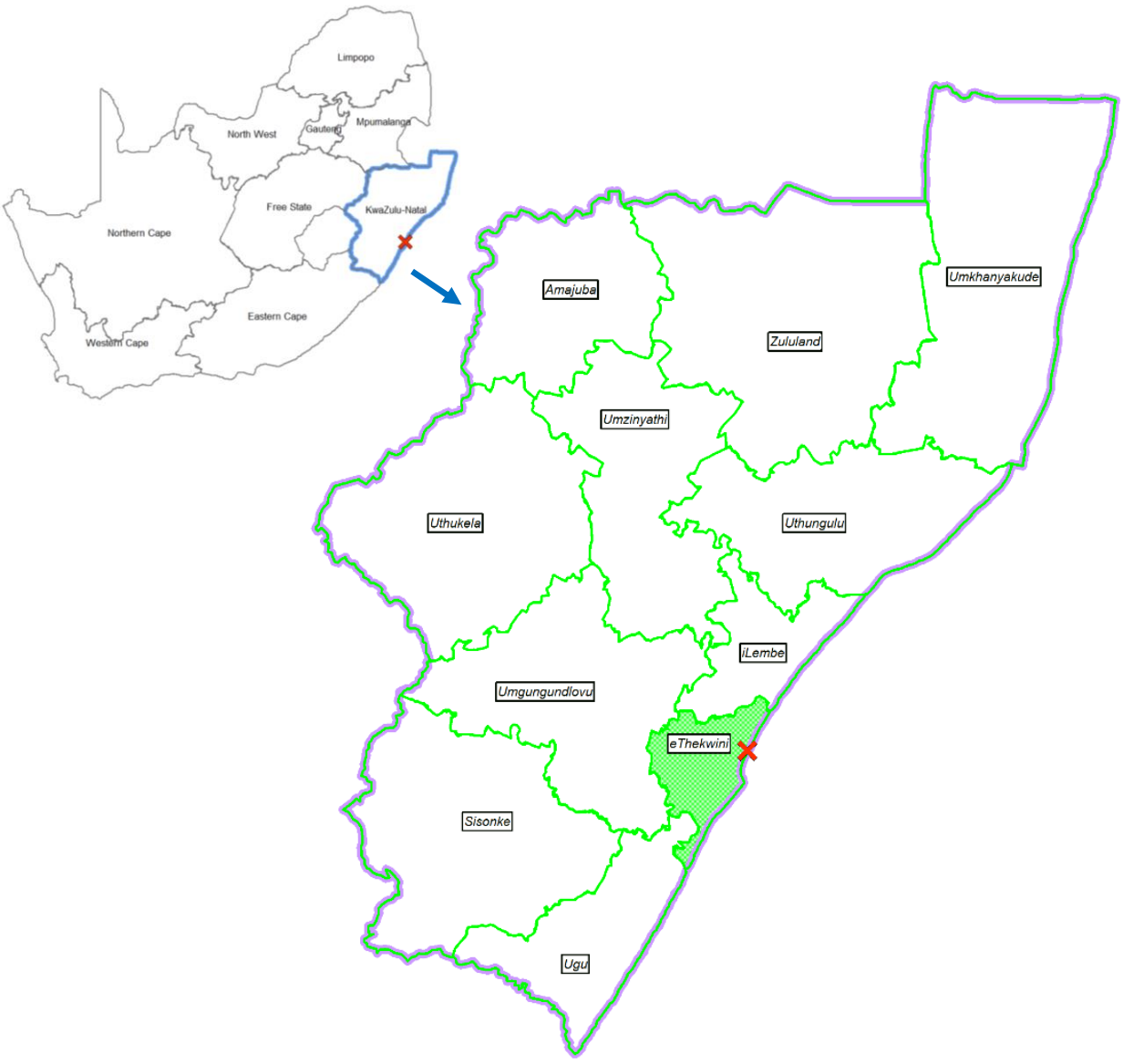


Figure 3: Regional locality map

Figure 4: Locality map

4.3 Project Components

4.3.1 Sewer Infrastructure

Precinct 2 of the Umhlanga Ridgeside Development can be divided into the upper and lower halves. The upper half of the Umhlanga Ridgeside Precinct 2 drains into the existing 750mm diameter bulk sewer main, which reticulates in a northerly direction to the Umhlanga Manors. Sewer reticulation services need to be provided to service the lower portion of Precinct 2 and Precinct 4 of the Umhlanga Ridgeside Development. The sewer infrastructure is proposed to feed into the existing Armstrong Avenue pump station.

The proposed sewer pipe will be approximately 250mm in diameter, and the length differs for each alternative option to be discussed in Section 5. The servitude to be registered for the proposed sewer line will be a minimum of 2m which will enable installation of the new manholes and sewer line to effectively maintain the servitude for future operational maintenance if necessary.

Three alternative options have been proposed for the sewer infrastructure, which will be discussed in detail in Section 5. The proposed construction servitudes for each option will also be discussed in Section 5.

4.3.2 Stormwater Infrastructure

Stormwater runoff needs to be managed between the Umhlanga Ridgeside Development and the M4 motorway, through the strip of forest, in order to ensure protection of the forest from siltation and pollutants, but to also ensure that the forest is not starved from runoff. A swale has already been constructed directly above the forest to mimic sheet flow conditions. The swale has a bio-retention function, with flow along the length of the swale having been restricted with small diameter pipes provided at regular intervals along the swale. There are two existing stormwater outfalls below the strip of the forest that convey stormwater through the lower residential area of Umhlanga to the ocean. The existing stormwater reticulation for Outfall 1 starts within La Lucia Ridge Office Estate and runs along the M41 and edge of the forest before crossing the M4 into Lower Umhlanga. There is a large depression storage zone for stormwater runoff at the south eastern end of the forest and adjacent to the pipeline which is able to drain into Outfall 1 once a certain level has been reached. For the central watercourse within Ridgeside, runoff currently drains through the forest towards the two pipe culverts on the M4 at the start of Outfall 2. There has been regular siltation of the existing pipe culvert structures on the M4 which has existed prior to the Umhlanga Ridgeside Development.

The BAR thus focuses on the safe conveyance and handling of stormwater runoff through the forest to existing pipe culverts on the M4 to Outfall 2. Three alternative options have been proposed for the stormwater infrastructure, which will be discussed in detail in Section 5. The proposed construction servitudes for each option will also be discussed in Section 5.

4.4 Resources Required for Construction

This section briefly outlines the resources that will be required to execute the project.

4.4.1 Water

During the construction stage, the Contractor(s) will require water for potable use by construction workers and water will also be used in the construction of the foundations for the substation and towers. The necessary negotiations will be undertaken with the municipality to obtain water from approved sources.

4.4.2 Sanitation

Sanitation services will be required for construction workers in the form of chemical toilets, which will be serviced at regular intervals by the supplier.

4.4.3 Roads

No new access roads are anticipated.

4.4.4 Waste

Solid waste generated during the construction phase will be temporarily stored at suitable locations (e.g. at construction camps) and will be removed at regular intervals and disposed of at approved waste disposal sites. All the waste disposed of will be recorded.

Wastewater, which refers to any water adversely affected in quality through construction-related activities and human influence, will include the following:

- Sewage;
- Water used for washing purposes (e.g. equipment, staff); and
- Drainage over contaminated areas (e.g. cement batching / mixing areas, workshop, equipment storage areas).

Suitable measures will be implemented to manage all wastewater generated during the construction period.

4.4.5 Electricity

Electricity will be obtained from diesel generators or temporary electricity connections during the construction phase.

4.4.6 Construction Workers

The appointed Contractor will mostly make use of skilled and unskilled labour during construction.

5 PROJECT ALTERNATIVES

5.1.1 Sewer Infrastructure

Figure 5 shows the three alternative options proposed for the sewer infrastructure, which are discussed in detail below. Refer to **Appendix 3** for a copy of the technical drawings. **Table 3** provides the location details for each sewer alternative option.

It is to be noted that the original EA in 2007 includes the approval of the construction of a 1.5ML sewage pump station above the forest within the Umhlanga Ridgeside Development in the south eastern end of Precinct 4, as well as a 520m long rising main to discharge into the existing bulk gravity 750mm diameter main at the M41/Ridgeside interchange. However, this option has abandoned in agreement with EMM as a result of EMM's policy to limit the number of pump stations that need to be serviced and instead support a gravity sewer system. Therefore three alternatives were considered for the sewer infrastructure.

Figure 5: Sewer alternative options

Table 3: Location details for the sewer infrastructure alternatives

	Alternative		
	1	2	3
Province	KZN Province		
Municipality	eThekwini Metropolitan Municipality		
Ward Number(s)	Ward 35		
Coordinates	Start: 29°44'42.46"S; 31°04'08.72"E Centre: 29°44'54.08"S; 31°04'09.53"E End: 29°45'05.96"S; 31°04'03.67"E	Start: 29°44'42.46"S; 31°04'08.72"E Centre: 29°44'53.58"S; 31°04'07.13"E End: 29°45'05.96"S; 31°04'03.67"E	Start: 29°44'42.46"S; 31°04'08.72"E Centre: 29°44'54.40"S; 31°04'09.03"E End: 29°45'05.96"S; 31°04'03.67"E
Property Affected	• Portion 140 of Erf 2406 Umhlanga Rocks (N0FU03510000240600140) • Portion 139 of Erf 2406 Umhlanga Rocks (N0FU03510000240600139) • Portion 144 of Erf 2406 Umhlanga Rocks (N0FU03510000240600144) • Portion 29 of LOT LA LUCIA 14634 (N0FU00000001463400029) • Portion 59 of LOT LA LUCIA 14634 (N0FU00000001463400059) • Portion 60 of LOT LA LUCIA 14634 (N0FU00000001463400060) • RE of Erf 2905 La Lucia (Armstrong Avenue) (N0FU01750000290500000) • RE of Erf 640 of La Lucia (N0FU01750000064000000) • Portion 61 of LOT LA LUCIA 14634 (N0FU00000001463400061) • Portion 84 of LOT LA LUCIA 14634 (N0FU00000001463400084)	• Portion 140 of Erf 2406 Umhlanga Rocks (N0FU03510000240600140) • Portion 139 of Erf 2406 Umhlanga Rocks (N0FU03510000240600139) • Portion 144 of Erf 2406 Umhlanga Rocks (N0FU03510000240600144) • Portion 29 of LOT LA LUCIA 14634 (N0FU00000001463400029) • Portion 59 of LOT LA LUCIA 14634 (N0FU00000001463400059) • Portion 60 of LOT LA LUCIA 14634 (N0FU00000001463400060) • RE of Erf 2905 La Lucia (Armstrong Avenue) (N0FU01750000290500000) • Portion 87 of LOT LA LUCIA 14634 (N0FU00000001463400087) • Portion 61 of LOT LA LUCIA 14634 (N0FU00000001463400061) • Portion 88 of LOT LA LUCIA 14634 (N0FU00000001463400088) • Portion 84 of LOT LA LUCIA 14634 (N0FU00000001463400084)	• Portion 140 of Erf 2406 Umhlanga Rocks (N0FU03510000240600140) • Portion 139 of Erf 2406 Umhlanga Rocks (N0FU03510000240600139) • Portion 144 of Erf 2406 Umhlanga Rocks (N0FU03510000240600144) • Portion 29 of LOT LA LUCIA 14634 (N0FU00000001463400029) • Portion 59 of LOT LA LUCIA 14634 (N0FU00000001463400059) • Portion 60 of LOT LA LUCIA 14634 (N0FU00000001463400060) • RE of Erf 2905 La Lucia (Armstrong Avenue) (N0FU01750000290500000) • Portion 61 of LOT LA LUCIA 14634 (N0FU00000001463400061) • Portion 84 of LOT LA LUCIA 14634 (N0FU00000001463400084)

5.1.1.1 Alternative 1

This option entails a 250mm diameter sewer pipeline of approximately 867m in length which starts from the boundary of the Glades Office Park, down the eastern side of Armstrong Avenue, to the Armstrong Avenue sewage pump station. This alignment is adjacent to the existing forest and within the road reserve. A pipe jack will be required across Armstrong Avenue.

The proposed construction servitude for this option is 5m wide. Thus, this option entails a footprint of 5m x 867m = 4 335m^2.

5.1.1.2 Alternative 2

This option follows the alignment of the existing registered sewer pipeline servitude and would entail upgrading the existing 160mm diameter pipeline to a 250mm diameter pipeline, approximately 884m in length. This option traverses through the forest and thus would require a method of installation to reduce as much disturbance as possible to the forest. The proposed least invasive method of installation is pipe cracking without changing the horizontal alignment or vertical profile of the existing sewer reticulation. This trenchless technology allows an existing network to be upgraded without removing the existing pipe which would cause disturbance to the environment.

The proposed pipe cracking method for Alternative 2 is described below. A bursting head is used as a conical tool that has a larger diameter than the existing pipe which is inserted into the existing pipe which fractures it when the head is pulled through. The rear of the bursting head is attached to a new pipe which is pulled via a cable and pulling rod. The pits required for the machinery are approximately 4m long by 2m wide and vary depending on the depth of the manholes. A TLB can be used to lift and install the necessary equipment into the pits within the servitude. The dimensions of the machinery and rods utilised in the operation is in the order of 1.5m long by 0.8m wide with a weight of approximately 800kg.

The following process for the pipe cracking method will be adopted:

- An insertion and reception pit is to be hand excavated in front of the manholes;
- All pits are to be shored adequately and a thrust block to be constructed in the pit or against each manhole wall, dependant on the pipe cracking technique used;
- Care would need to be adhered to in the butt-welding of the polyethylene pipe by a specialised team prior to the cracking operation with care being taken in the transportation and storage of the pipe;
- Installation of rigid pulling rods which are threaded from the reception pit at the end of the line, through the existing pipe until the insertion pipe is reached thereafter the rods are attached to the bursting head. This will also depend on the preferred technique used by the Contractor;
- Pipes installed in segments would need to adhere to removal of the pulling plate from the previous joint installed;
- Setting of the new pipe and fixing it to the previous pipe section;

- Pushing the rods back through the newly installed section of pipe;
- Set the pulling plate which is attached to the rods which apply the pulling force as required;
- Change the machine setting to ”pull mode”. This process will continue until such time the bursting head is completely pulled into the reception pit at the end of the line before entry into the pump station; and
- During this operation, over pumping sewage between manholes will need to take place and once construction is complete, the sewer pipeline construction servitude would need to be reinstated as per the EMPr.

The proposed construction servitude for this option is 3m wide. Thus, this option entails a footprint of 3m x 884m = 2 652m^2.

5.1.1.3 Alternative 3

This option follows a similar alignment to Alternative 1 and entails a 250mm diameter sewer pipeline of approximately 830m in length which starts from the boundary of the Glades Office Park, down the western side of Armstrong Avenue, to the Armstrong Avenue sewage pump station. This alignment is adjacent to the existing forest and within the road reserve. A pipe jack will be required across Armstrong Avenue.

The proposed construction servitude for this option is 5m wide. Thus, this option entails a footprint of 5m x 830m = 4 150m^2.

5.1.2 Stormwater Infrastructure

Three alternative options are proposed for the stormwater infrastructure, which are discussed in detail below. Refer to **Appendix 3** for a copy of the technical drawings. All three stormwater infrastructure alternatives fall on Portion 139 and 147 of Erf 2406 Umhlanga Rocks. **Table 4** provides the location details for each sewer alternative option.

Table 4: Location details for the stormwater infrastructure alternatives

	Alternative		
	1	2	3
Province	KZN Province		
Municipality	eThekwini Metropolitan Municipality		
Ward Number(s)	Ward 35		
Coordinates	Start: 29°44'14.82"S; 31°04'25.94"E Centre: 29°44'16.78"S; 31°04'29.30"E End: 29°45'17.72"S; 31°04'32.69"E	Start: 29°44'12.22"S; 31°04'26.00"E Centre: 29°44'16.41"S; 31°04'28.66"E End: 29°45'17.56"S; 31°04'32.35"E	Start: 29°44'14.82"S; 31°04'25.94"E Centre: 29°44'16.78"S; 31°04'29.30"E End: 29°45'17.72"S; 31°04'32.69"E

	Alternative		
	1	2	3
Property Affected	• Portion 147 of Erf 2406 Umhlanga Rocks (N0FU03510000240600147) • Portion 139 of Erf 2406 Umhlanga Rocks (N0FU03510000240600139)	• Portion 147 of Erf 2406 Umhlanga Rocks (N0FU03510000240600147) • Portion 139 of Erf 2406 Umhlanga Rocks (N0FU03510000240600139)	• Portion 147 of Erf 2406 Umhlanga Rocks (N0FU03510000240600147) • Portion 139 of Erf 2406 Umhlanga Rocks (N0FU03510000240600139)

5.1.2.1 Alternative 1

This option entails a 1200mm diameter reinforced polyethylene stormwater drainage pipe, approximately 215m in length, starting from the stormwater outlet control structure below the lower attenuation pond in Precinct 4 through the forest to end at the existing pipe culverts on the M4 (**Figure 6**).

Figure 6: Stormwater Alternative 1

This option traverses through the forest and thus would require a method of installation to reduce as much disturbance as possible to the forest. The proposed alignment was designed to avoid as many trees as possible as well as to limit the depth of excavation so as to limit any damage to tree roots. The proposed reinforced polyethylene material also allows for a less

intrusive installation as it requires labour for hand installation (not machinery) and light construction equipment.

The proposed construction servitude for this option is 5m wide. Thus, this option entails a footprint of 5m x 215m = 1 075m^2.

The proposed method statement for Alternative 1 is described below.

- The pipeline route will be pegged and the construction servitude will be demarcated such that no personnel and construction equipment will be permitted beyond this area;
- Any trees/shrubs identified to be relocated/replanted will be carefully marked, verified, removed and replanted under supervision of the Environmental Control Officer (ECO);
- Construction of the pipeline will take place working up from the existing pipe culverts on the M4 through the forest to the lower attenuation pond;
- All excavations will be undertaken by hand and will be limited to 1.5m in depth;
- The sections of pipe will be carefully winched into place, backfilled by hand and compacted to the required compaction using small compaction equipment;
- Cover to the stormwater pipeline will be limited to 700mm;
- Use of drystack retaining blocks will be made where required to limit the height of fill to no more than 300mm around the tree trunks;
- Material required for operations for the day to be stockpiled in the servitude to prevent time lost to cart construction material and further disturbance; and
- Vegetation to be reinstated and rehabilitated after construction is complete.

5.1.2.2 Alternative 2

This option entails the construction of a level spreader weir and overland stormwater control measures through the forest between the lower attenuation pond and the existing pipe culverts on the M4 (**Figure 7**).

This option involves drawing off the runoff that will be discharged from the lower attenuation pond into the spillway and discharging this runoff evenly over a reno-mattress laid level (over a length of approximately 30m) to mimic overland sheet flow conditions. In order to ensure that the runoff is not concentrated and sheet flow conditions are maintained through the forest, it is proposed that silt fences and UV resistant sandbags be placed at regular intervals (level along existing contour in each case) down to the existing pipe culverts on the M4.

This option entails a footprint of approximately 50m x 260m = 13 000m^2.

Figure 7: Stormwater Alternative 2

The proposed method statement for Alternative 2 is described below.

- The existing contours will need to be determined working up the watercourse from the M4 through the forest to the lower attenuation pond;
- The contours of the same height interval would need to be demarcated with wooden stakes so as to assist in placing rows of silt fences and UV resistant sandbags at regular contour intervals up the watercourse through the forest. This would require some clearing/removal of existing undergrowth however silt fences and UV resistant sandbags would be placed taking existing trees into account;
- Once the silt fences and UV resistant sandbags are in place, the level spreader weir structure will be constructed; and
- Regular inspections after rainfall events are to take place to ensure that sheet flow conditions are maintained and any areas where there is erosion or siltation is addressed and supplemented with additional sandbags or possibly reno mattresses or hand packed rock.

5.1.2.3 Alternative 3

This option entails the construction of a shallow stormwater channel of approximately 215m in length and riffle control weir structures through the forest between the lower attenuation pond and the existing pipe culverts on the M4 (**Figure 8**).

Figure 8: Stormwater Alternative 3

This option involves drawing off the runoff that will be discharged from the lower attenuation pond into the spillway and discharging this runoff into the stormwater channel. A constant slope of 0.5% was preferred and a number of riffle control weir structures, 0.5m in height was proposed to dissipate the energy/velocity in the stormwater channel. To further assist in energy dissipation, dump rock shall be suitably placed by hand below the riffle control weir structures. Silt fences and UV resistant sandbags shall be constructed across the stormwater channel at suitable intervals to prevent any erosion and siltation.

This option entails a footprint of 20m x 215m = 4 300m^2.

The proposed method statement for Alternative 3 is described below.

- The extent of the stormwater channel will be pegged and the construction servitude will be demarcated such that no personnel and construction equipment will be permitted beyond this area;
- The construction of the stormwater channel will take place working up the watercourse from the M4 through the forest to the lower attenuation pond;
- All excavations will be undertaken by hand to form a wide shallow stormwater channel of 0.5m in depth;
- UV resistant sandbags shall be suitably placed to protect tree trunks and roots where encountered in excavations;

- Material required for operations for the day to be stockpiled in the servitude to prevent time lost to cart construction material and further disturbance;
- Regular inspections after rainfall events are to address any erosion or siltation along the stormwater channel, however all runoff should be maintained within the channel; and
- Vegetation to be reinstated and rehabilitated after construction is complete.

5.2 No-Go Option

If the proposed stormwater and sewer infrastructure development does not go ahead, the existing Umhlanga Ridgeside Development (which consists of residential, commercial and resort developments) will not have adequate stormwater and sewer infrastructure in place, which places immense pressure to tie into existing structures which do not have the capacity for more developments in the area, which has health and environmental impacts if leaks or bursts occur. If the proposed stormwater and sewer infrastructure is not constructed then the construction of the mixed land use development will be hindered, and thus have a negative impact on the overall employment and social benefits provided by the construction and operational phase of the Umhlanga Ridgeside Development. In addition, if no stormwater control measures are put in place, the environmental impacts in the proposed area include erosion and flooding (which includes the forest area).

6 LEGISLATION AND GUIDELINES CONSIDERED

6.1 Overview of Legislation

Some of the pertinent environmental legislation that has bearing on the proposed development is captured below (**Table 5**). More detailed information is provided from **Section 6.2** to **6.14**. This Section aims to satisfy 3(1)(e) of Appendix 1 of GN No. R. 982: A description of the policy and legislative context within which the development is proposed including:

i) An identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the preparation of the report; and

ii) How the proposed activity complies with and responds to the legislation and policy context, plans, guidelines, tools frameworks, and instruments.

Table 5: Environmental legislative framework

Legislation	Relevance
Constitution of the Republic of South Africa (Act 108 of 1996)	• Chapter 2 – Bill of Rights. • Section 24 – environmental rights.

Legislation	Relevance
National Environmental Management Act (Act No. 107 of 1998)	• Section 24 – Environmental Authorisation (control of activities which may have a detrimental effect on the environment). • Section 28 – Duty of care and remediation of environmental damage. • Environmental management principles. • Authority – KZN EDTEA.
GN No. R 982 of 04 December 2014, as amended	• Process for undertaking BA/ Scoping and EIA.
GN No. R. 983 of 04 December 2014, as amended (Listing Notice 1)	• Activities that need to be assessed through a BA Process.
GN No. R. 985 of 04 December 2014, as amended (Listing Notice 3)	• Activities that need to be assessed through a BA Process – related to sensitive environments in specific Provinces.
National Water Act (Act No. 36 of 1998)	• Chapter 3 – Protection of water resources. • Section 19 – Prevention and remedying effects of pollution. • Section 20 – Control of emergency incidents. • Chapter 4 – Water use. • Authority – Department of Water and Sanitation (DWS).
National Environmental Management: Protected Areas Act (Act No. 57 of 2003)	• Protection and conservation of ecologically viable areas representative of South Africa's biological diversity and natural landscapes. • Authority – Department of Environmental Affairs (DEA)
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)	• Management and conservation of the country's biodiversity. • Protection of species and ecosystems. • Authority – DEA.
National Environmental Management Air Quality Act (Act No. 39 of 2004)	• Air quality management • Section 32 – dust control. • Section 34 – noise control. • Authority – DEA and EMM.
National Environmental Management: Waste Act (Act No. 59 of 2008)	• Chapter 5 – licensing requirements for listed waste activities (Schedule 1) • Authority – DEA.
Occupational Health & Safety Act (Act No. 85 of 1993)	• Provisions for OHS • Authority – Department of Labour.
National Heritage Resources Act (Act No. 25 of 1999)	• Section 34 – protection of structure older than 60 years. • Section 35 – protection of heritage resources. • Section 36 – protection of graves and burial grounds. • Section 38 – Heritage Impact Assessment for linear development exceeding 300m in length; development exceeding 5 000m2 in extent. • Authority – KZN AMAFA (Heritage) and South African Heritage Resources Authority (SAHRA)
KZN Heritage Act (Act No. 04 of 2008)	• Conservation, protection and administration of both the physical and the living or tangible heritage resources of KZN. • Authority – KZN AMAFA (Heritage)
Conservation of Agricultural Resources Act (Act No. 43 of 1983)	• Control measures for erosion. • Control measures for alien and invasive plant species. • Authority – KZN Department of Forestry and Fisheries (DAFF)

Legislation	Relevance
National Forests Act (No. 84 of 1998)	• Section 15 – Authorisation required for impacts to protected trees. • Authority – DAFF
Kwazulu-Natal Planning and Development Act (Act No. 06 of 2008)	• Directs and regulates planning and development in KZN. • An application may be required before land may be used or developed for a particular purpose. • All developments need to be in accordance with the municipality's planning scheme. • Authority – EMM
KwaZulu-Natal Nature Conservation Management Act (Act No. 09 of 1997).	• Institutional bodies for nature conservation in KZN. • Establish control and monitoring bodies and mechanisms. • Authority – Ezemvelo KZN Wildlife.

6.2 Constitution of the Republic of South Africa (Act No. 108 of 1996)

The Constitution of the Republic of South Africa (Act No. 108 of 1996) is the supreme law of the land and provides amongst others the legal framework for legislation regulating coastal management in general. It also emphasises the need for co-operative governance. In addition, the Environmental clause in Section 24 of the Constitution provides that:

"Everyone has the right –

to an environment which is not harmful to their health or wellbeing;

to have the environment protected for the benefit of present and future generations through reasonable legislation and other measures that:

Prevent pollution and ecological degradation;

Promotes conservation;

Secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social development"

The Constitution provides the overarching framework for sustainable development.

6.3 National Environmental Management Act (Act No. 107 of 1998)

The proposed Stormwater and Sewer Infrastructure for the Umhlanga Ridgeside Development requires authorisation in terms of NEMA, and the BA will be undertaken in accordance with the 2014 EIA Regulations, as amended (07 April 2017).

Important aspects of NEMA are sustainability principles such as the "Polluter Pays" and the "Precautionary Principle" which will also be taken into account in the assessment of the impacts of the proposed development.

6.3.1 2014 EIA Regulations, as amended (07 April 2017)

The EIA Regulations consist of the following:

- EIA Procedures - GN No. R. 982;
- Listing Notice 1 - GN No. R. 983;
- Listing Notice 2 - GN No. R. 984; and
- Listing Notice 3 - GN No. R. 985.

It must be noted that the different alternatives considered triggered different Listed Activities as result of their location. The Listed Activity applied for below is only for the recommended alternatives for both the proposed Stormwater and Sewer Infrastructure for the Umhlanga Ridgeside Development. An Activity in Listing Notice 3 was triggered and thus the project was subjected to a BA Process. The Listed Activity is provided below in **Table 6**.

Table 6: Listed Activity triggered by the proposed project

Listed Activity	Listed Activity Description per project
GN No. R. 985 – Activity 12 (d)(iv, v and vii) The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. (d) In Kwazulu-Natal: (iv) Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; (v) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (vii) On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.	The proposed construction of the stormwater and sewer infrastructure will result in the clearance of an endangered and critically endangered threatened ecosystem (endangered KwaZulu-Natal Coastal Belt Grassland and the critically endangered KwaZulu-Natal Dune Forests). The proposed developments also fall within the KwaZulu-Natal Critical Biodiversity Area: Irreplaceable and also within D'MOSS areas and thus trigger this Listed Activity. The approximate vegetation clearance amounts to 0.09ha for the stormwater infrastructure alternative 1 and also 0.09ha for the sewer infrastructure alternative 3.

6.4 National Water Act (Act No. 36 of 1998)

The National Water Act (Act No. 36 of 1998) (NWA) regulates water resources of South Africa. Water is considered a scarce commodity and should therefore be adequately protected. Amongst others, the act deals with the protection of water sources, water uses, water management strategies and catchment management, dam safety and general powers and functions. The purpose of the act is to ensure that South Africa's water resources are protected, used, developed, conserved, managed and controlled. The NWA includes the definition of a Water Resource.

The NWA definition for a Water Resource includes:

1. A Watercourse;
2. Surface Water;
3. An Estuary; and
4. An Aquifer.

The NWA defines a watercourse as follows:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse include, where relevant, its bed and banks.

The Act also specifies that a wetland is defined as land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil. Section 21 of the NWA provides information on what water uses require approval, i.e. a Water Use License (WUL). These include:

a) Taking water from a water resource;
b) Storing water;
c) Impeding or diverting the flow of water in a watercourse;
d) Engaging in a stream flow reduction activity;
e) Engaging in a controlled activity;
f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) Disposing of waste in a manner which may detrimentally impact on a water resource;
h) Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
i) Altering the bed, banks, course or characteristics of a watercourse;
j) Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
k) Using water for recreational purposes.

Any development within the riparian habitat or 1:100 year floodline whichever is the greatest distance from the watercourse, will require an authorisation from the Department. In addition, the General Authorisation (GA) in terms of Section 39 of the NWA (GN No 40229 published in Government Gazette No. 509, dated 27 July 2016) states that a regulated area of a watercourse includes: “A 500 m radius from the delineated boundary (extent) of any wetland or pan”.

As the proposed development occurs within 500m of a wetland, a Water Use License Application (WULA) will be required and will be undertaken separately to the BA Process. A Wetland Delineation Impact Assessment was undertaken to assess the impacts, refer to **Appendix 7C** for the study.

6.5 National Environmental Management: Protected Areas Act (Act No. 57 of 2003)

The aim of the National Environmental Management: Protected Areas Act (NEMPA) (Act No. 57 of 2003) is to provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and natural seascapes. The purpose of a Protected Environment is amongst others to protect a specific ecosystem outside a special nature reserve world heritage site or nature reserve and also to ensure the use of the natural resources in the area is sustainable.

The proposed development does not occur near any Protected Areas.

6.6 National Environmental Management: Biodiversity Act (Act 10 of 2004)

The National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004) was promulgated for the management and conservation of South Africa's biodiversity through the protection of species and ecosystems and the sustainable use of indigenous biological resources.

The main implication of this act is the protection of biodiversity. The proposed development occurs within Critical Biodiversity Areas (CBAs) and thus potential impacts on terrestrial ecosystems needs to be assessed. A Terrestrial Ecological Impact Assessment was undertaken to assess the impacts, refer to **Appendix 7A** for the study.

6.7 National Environmental Management: Air Quality Act (Act No. 39 of 2004)

The National Environmental Management: Air Quality Act (Act No. 39 of 2004) provides for the setting of national norms and standards for regulating air quality monitoring, management and control and describes specific air quality measures so as to protect the environment and human health or well-being by:

- Preventing pollution and ecological degradation; and
- Promoting sustainable development through reasonable resource use.

It also includes measures for the control of dust, noise and offensive odours that may be relevant to the construction. No Air Emissions License will be required for the proposed development; however, the potential impacts on air quality will be discussed in Section 17.

6.8 National Environmental Management: Waste Act (Act No. 59 of 2008)

The National Environmental Management Waste Act (NEM: WA) (Act No. 56 of 2008) regulates waste management in order to protect the health and environment of South African citizens. This is achieved through pollution prevention, institutional arrangements and planning

matters, national norms and standards and the licensing and control of waste management activities.

The list of waste management activities that have or are likely to have a detrimental effect (GN No. 921 of 29 November 2013) contains activities listed in Categories A and B that would require licensing from the provincial or national authorities and activities contained in Category C which would require meeting the requirements of various Norms and Standards.

No authorisation will be required in terms of the NEM: WA (Act No. 59 of 2008), as the project will not include any listed waste management activities.

6.9 Occupational Health & Safety Act (Act No. 85 of 1993)

The Occupational Health and Safety Act (Act No. 85 of 1993) provides for the health and safety of people at work as well as the health and safety of persons using plant and machinery.

Tongaat Hulett will be required to meet the requirements of the OHS Act during the construction of the proposed stormwater and sewer infrastructure.

6.10 National Heritage Resources Act (Act No. 25 of 1999)

The National Heritage Resources Act (NHRA) (Act No. 25 of 1999) was promulgated for the protection of National Heritage Resources and the empowerment of civil society to conserve their heritage resources.

In terms of Section 38 of this act, certain categories as listed below require a Heritage Impact Assessment. These categories are:

(a) the construction of a road, wall, power line, **pipeline, canal or other similar form of linear development or barrier exceeding 300m in length**;

(b) the construction of a bridge or similar structure exceeding 50m in length;

(c) any development or other activity which will change the character of a site

(i) exceeding 5 000 m^2 in extent; or

(ii) involving three or more existing erven or subdivisions thereof; or

(iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or

(iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

(d) the rezoning of a site exceeding 10 000 m^2 in extent; or

any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development,

notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

The NHRA also makes provision for General Protections, which apply automatically to certain categories of heritage resources such as archaeological and paleontological sites, cemeteries and graves, and structures older than 60 years.

Based on the length of the proposed sewer infrastructure alternatives (above 300m in length), a Phase 1 Heritage Impact Assessment (HIA) is required, refer to **Appendix 7B** for the study. The stormwater infrastructure alternatives fall below the threshold and thus were not assessed in the HIA.

6.11 Conservation of Agricultural Resources Act (Act No. 43 of 1983)

The Conservation of Agricultural Resources Act (Act No. 43 of 1983) (CARA) requires the maintenance of riparian vegetation and provides a list of invasive alien vegetation that must be controlled or eradicated. The control of invasive vegetation will be discussed in the EMPr.

6.12 National Forest Act (Act 84 of 1998)

In terms of the National Forests Act (Act 84, 1998), trees in natural forests or protected tree species (as listed in Government Gazette Notice 1012 of 27 August 2004) may not be cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold - except under licence granted by the DAFF.

This Act was considered in the Terrestrial Ecological Impact Assessment (**Appendix 7A**) in terms of the occurrence of any Protected Trees on the proposed study area.

6.13 The KZN Nature Conservation Management Act (Act No. 9 of 1997)

The KZN Nature Conservation Management Act (Act No. 9 of 1997) provides for the establishment of the KZN Nature Conservation and prescribes its powers, duties and functions which include:

- Direct Nature conservation management; and
- Direct Protected areas management.

This is currently carried out by Ezemvelo KZN Wildlife.

6.14 Policy, Programmes, Guidelines and Plans

6.14.1 Guidelines

The following guidelines were used in the preparation of this report.

- Integrated Environmental Management Information Series, in particular Series 2 – Scoping (DEAT, 2002);
- Guideline on Alternatives: NEMA Environmental Impact Assessment Regulations (prepared by the Western Cape Department of Environmental Affairs and Development Planning, 2006);
- Guideline 3: General Guide to the Environmental Impact Assessment Regulations, 2005. Integrated Environmental Management Guideline Series (DEAT, 2005a);
- Guideline 4: Public Participation, in support of the EIA Regulations. Integrated Environmental Management Guideline Series (DEAT, 2005);
- Guideline on Need and Desirability, NEMA Environmental Impact Assessment Regulations Guideline and Information Document Series. Department of Environmental Affairs and Development Planning (DEADP, 2009); and
- Assessment of alternatives and impacts (Guideline 5) in support of the EIA Regulations, Department of Environmental Affairs and Tourism, Pretoria (DEAT, 2006).

6.14.2 Policies

The following regional plans will be considered:

- National Development Plan;
- Spatial Development Frameworks;
- Integrated Development Frameworks; and
- Relevant provincial, district and local policies and strategies.

The need for the project may be linked to these existing policies and strategies.

7 BASIC ASSESSMENT PROCESS

7.1 2014 EIA Listed Activities (as amended)

The proposed Stormwater and Sewer Infrastructure for the Umhlanga Ridgeside Development entails certain activities that require authorisation in terms of NEMA. Refer to Section 6 for a further discussion on the legal framework.

The process for seeking authorisation is undertaken in accordance with the 2014 EIA Regulations, as amended (07 April 2017), promulgated in terms of Chapter 5 of NEMA.

Based on the types of activities involved, which includes the Listed Activity in GN No. R. 985 (see **Table 5**), the requisite environmental assessment for the project is a BA Process.

7.2 Competent Authority

In terms of the Regulations, the lead decision-making authority for the BA Process is KZN EDTEA, as the project proponent is Tongaat Hulett, a private developer.

7.3 Formal Process

An outline of the BA Process for the proposed Stormwater and Sewer Infrastructure for the Umhlanga Ridgeside Development is provided in **Figure 9**.

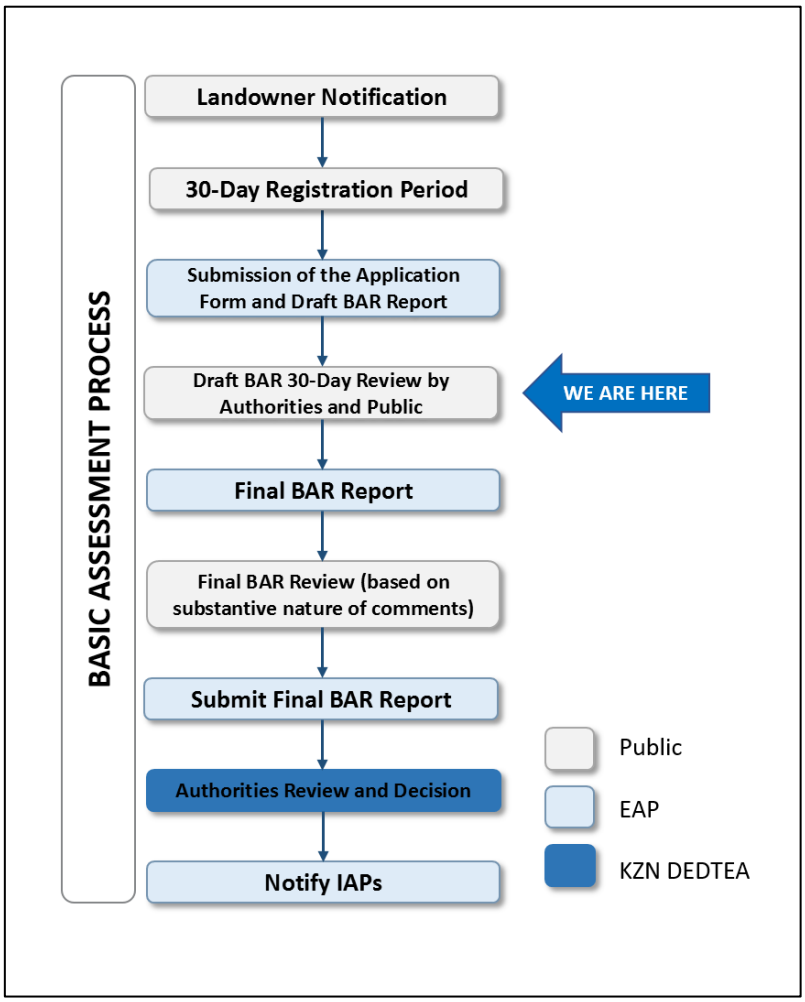


Figure 9: Overview of BA Process

7.4 Landowner Consent and Notification

According to Regulation 39(1) of GN No. R 982 of the 2014 EIA Regulations (as amended), if the proponent is not the owner or person in control of the land on which the activity is to be undertaken, the proponent must, before applying for an environmental authorisation in respect of such activity, obtain the written consent of the landowner or person in control of the land to undertake such activity on that land.

This requirement does not apply *inter alia* for linear developments (e.g. pipelines, power lines, roads) or if it is a Strategic Integrated Project (SIP) as contemplated in the Infrastructure Development Act (2014). Thus landowner consent is not required.

Refer to **Appendix 6B** for landowner notification.

7.5 Application Form

An Application Form, in terms of Regulation 16 of Government Notice No. R. 982 of the 2014 EIA Regulations (as amended), will be submitted to KZN EDTEA together with the Draft BAR. Refer to **Appendix 5** for a copy.

7.6 Public Participation and Review of BAR

The Draft BAR will be made available to IAPs for a 30-Day Review Period from 14 November 2018 to 14 December 2018. All comments received will be taken into account in the Final BAR and will also be included in the Comments and Response Report.

More detail on the Public Participation Process is provided in **Section 13**.

8 Assumptions and Limitations

The following assumptions were made during the BA Process:

- The detailed engineering design will be finalised at a later stage. The conditions of the EA, if issued, must be factored into the final design;
- As the design of the project components is still in feasibility stage, and due to the dynamic nature of the planning environment, the dimensions and layout of the infrastructure may change during the detailed design phase;
- The findings of the Impact Assessment are informed by the Specialist reports which are assumed to be accurate; and
- The mitigation measures provided in the EMPr will be implemented and it assumed that the measures are adequate and will successfully enhance positive impacts while limit the negative impacts.

9 Need and Desirability

In terms of 3(1)(f) of Appendix 1 of GN No. R. 982 of the 2014 EIA Regulations (as amended), this section discusses the need and desirability of the project. The format contained in the Guideline on Need and Desirability (DEA&DP, 2009) has been used in **Table 7**.

Table 7: Need and desirability

No.	Question	Response
NEED ('timing')		
1.	Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved Spatial Development Framework (SDF) agreed to by the relevant environmental authority? (i.e. is the proposed development in line with the projects and programmes identified as priorities within the IDP).	The EMM SDF (2017/2018-2021/2022) makes mention of the Umhlanga Ridgeside mixed use development. In the SDF, the eThekwini Land Use Management Framework acknowledges that this development is one of many that drives the Municipality's income as they create quality work environments such as the La Lucia Office Park; and robust Industrial parks such as River Horse Valley and the emerging Cornubia Industrial Area; not to mention quality recreational spaces such as the Umhlanga Promenade. With regards to the proposed development (sanitation service provision), the SDF states that the provision of acceptable basic services is a critical element in the national developmental agenda, specifically sanitation, which is one of the key critical services which have been identified by communities that are required to meet their basic needs. In terms of the proposed stormwater control measures, the SDF supports sustainable catchment management and stormwater practices. Strategy 1 in the SDF (Manage urban growth, construct and maintain viable built environment and sustain natural environments and resources) is informed by the principle of sustainable environmental planning.
2.	Should development, or if applicable, expansion of the town/area concerned in terms of this land use (associated with the activity being applied for) occur here at this point in time?	Yes. The proposed stormwater and sewer infrastructure is required to service the Umhlanga Ridgeside Development currently being constructed.
3.	Does the community/area need the activity and the associated land use concerned (is it a societal priority)? This refers to the strategic as well as local level (e.g. development is a national priority, but within a specific local context it could be inappropriate)	The Umhlanga Ridgeside Development (currently being constructed) requires the provision of sewer and stormwater services in order to function and operate. The proposed infrastructure is required as there is no capacity to tie into the existing networks.
4.	Are the necessary services with appropriate capacity currently available (at the time of application), or must additional capacity be created to cater for the development?	The proposed development is for the provision of services to the Umhlanga Ridgeside Development.
5.	Is this development provided for in the infrastructure planning of the municipality, and if not what will the implication be on the infrastructure planning of the municipality (priority and placement of services)?	Yes, the proposed sewer and stormwater infrastructure have been designed in consultation with EMM.

6.	Is this project part of a national programme to address an issue of national concern or importance?	The proposed development is for the Umhlanga Ridgeside Development only.
DESIRABILITY ('placing')		
7.	Is the development the best practicable environmental option (BPEO) for this land/site?	Alternative options have been investigated for both the stormwater and sewer infrastructure. Refer to Section 17 for the comparative analysis of alternatives selecting the BPEO.
8.	Would the approval of this application compromise the integrity of the existing approved municipal IDP and Spatial Development Framework (SDF) as agreed to by the relevant authorities?	It is not anticipated that the proposed development will contradict or be in conflict with the IDP and SDF for EMM.
9.	Would the approval of this application compromise the integrity of the existing environmental management priorities for the area (e.g. as defined in EMFs), and if so, can it be justified in terms of sustainability considerations?	The proposed development occurs within a forest. A number of mitigation measures have also been provided by the Terrestrial Ecological Specialist to minimise the impact on the forest and these have been incorporated into the EMPr contained in **Appendix 8**.
10.	Do location factors favour this land use (associated with the activity applied for) at this place? (this relates to the contextualisation of the proposed land use on this site within its broader context).	Yes. The proposed stormwater and sewer infrastructure is required to service the Umhlanga Ridgeside Development currently being constructed.
11.	How will the activity or the land use associated with the activity applied for, impact on sensitive natural and cultural areas (built and rural/natural environment)?	Refer to Section 16 for an assessment of the project's potential impacts.
12.	How will the development impact on people's health and wellbeing (e.g. i.t.o. noise, odours, visual character and sense of place, etc)?	
13	Will the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs?	There will be no unacceptable opportunity costs.
14	Will the proposed land use result in unacceptable cumulative impacts?	There will be no change in land use for the proposed development. However, cumulative impacts are discussed in Section 16.11.

10 TIMEFRAMES

In terms of 3(1)(q) of Appendix 1 of GN No. R. 982 of the amended 2014 EIA Regulations (07 April 2017), this section discusses the period for which the EA is required, the date on which the activity will be concluded, and the post construction monitoring requirements finalised. These proposed timeframes are provided in **Table 8**. The project is currently in its feasibility phase. The timeframes are confirmed after the design phase and when the project is in execution phase. These timeframes are usually determined after EA is obtained.

Table 8: Timeframes

Requirement	Proposed Timeframe
Environmental Authorisation	May 2019
Pre-Construction	TBC
Construction	TBC
Post Construction Monitoring	TBC

11 FINANCIAL PROVISIONS

In terms of 3(1)(s) of Appendix 1 of GN No. R. 982 of the amended 2014 EIA Regulations (07 April 2017), this section discusses details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts.

Due to the sensitive nature of financial provisions, Tongaat Hulett cannot detail the exact amounts but can confirm that there is sufficient amount of finances to ensure the project can be completed.

12 PUBLIC PARTICIPATION PROCESS

12.1 General

The purpose of the public participation process for the proposed development includes:

- Providing IAPs with an opportunity to obtain information about the project;
- Allowing IAPs to express their views, issues and concerns with regard to the project;
- Granting IAPs an opportunity to recommend measures to avoid or reduce adverse impacts and enhance positive impacts associated with the project; and
- Enabling the project team to incorporate the needs, concerns and recommendations of IAPs into the project, where feasible.

The public participation process that was followed for the proposed project is governed by NEMA and GN No. R. 982 of the 2014 EIA Regulations, as amended. Details of the process are provided below. All public participation material can be referred to in **Appendix 6**.

12.2 Pre-Application Consultation

A Pre-Application Consultation Meeting was held with KZN EDTEA on 17 May 2017 (refer to **Appendix 6D** for a copy of the minutes of the meeting). The purpose of the meeting included the following:

- To provide an overview of the project to KZN EDTEA;

- To present the approach to the BA Process; and
- To determine KZN EDTEA's requirements.

12.3 Project Announcement – Initial IAP Registration Period

Nemai Consulting commenced with initial public notification in May 2017 in which adjacent landowners/occupiers, key regulatory authorities, stakeholders and the public were informed about the proposed project.

12.3.1 Identification of IAPs and Compilation of IAP Database

IAPs were identified based on regulatory requirements and the specific site/project requirements. However, in summary, the database includes the following:

- Directly affected landowners;
- Directly adjacent landowners and tenants;
- Stakeholders that may not be directly affected by the project but may be interested in the development;
- Businesses and Rate Payer's Associations in the surrounding areas;
- Organs of State that may have an interest in the project; and
- Key Organs of State/Authorities that will comment on the BAR, including:
    - KZN EDTEA;
    - DEA;
    - Ezemvelo KZN Wildlife;
    - KZN Regional DWS;
    - KZN DAFF;
    - KZN Heritage Authority (AMAFA);
    - SAHRA;
    - EMM, including:
        - City Manager;
        - Infrastructure Management and Social-Economic Development Department;
        - Roads and Stormwater;
        - Environmental Planning and Climate Protection Department; and
        - Ward Councillor for Ward No. 35.

A copy of the IAP database to date is available in **Appendix 6A**.

12.3.2 Initial IAP Registration

The notification process undertaken is detailed in the sections to follow:

12.3.2.1 Background Information Document (BID)

BIDs, which included a Reply Form, were distributed by email or hand delivered to IAPs contained in the IAP Database. BIDs contained a brief background and description of the

project, as well as the EIA Process, and listed the details for submitting comments regarding the proposed development. The BID served to notify IAPs of the project and the details on how to register as an IAP.

Project announcement took place in May 2017 and the 30 Day registration period took place from 22 May 2017 to 22 June 2017. Proof of initial notification is provided in **Appendix 6B**. All reply forms and comments from registered IAPs to date are included in **Appendix 6C**.

12.3.2.2 Site Notices

Five site notices were placed at strategic points around the study area (**Table 9**).

Table 9: Locations of site notices

No.	Coordinates
1	29°45'06.39"S; 31°04'03.82"E
2	29°44'51.31"S; 31°04'07.73"E
3	29°44'44.32"S; 31°04'08.18"E
4	29°44'19.19"S; 31°04'35.52"E
5	29°45'09.09"S; 31°04'01.44"E

Proof of site notices are provided in **Appendix 6B**. Notification of the proposed development and how to register as an IAP were provided on the site notice.

12.3.2.3 Update of IAP Database

The IAP Database was updated throughout the registration period.

12.4 Review Process for the Draft BAR

12.4.1 30-Day Public Review Period

In accordance with GN No. R. 982 of the amended 2014 EIA Regulations (07 April 2017), IAPs were granted an opportunity to review and comment on the Draft BAR. A hardcopy of the document was placed at the La Lucia Public Library, details provided in **Table 10**. A link to the electronic copy was also available. Emails were sent to all registered IAPs to notify them of the review period of the Draft BAR. The 30-Day public review period will take place from **14 November 2018 to 14 December 2018**.

Table 10: Location of Draft BAR for review

Venue	Address	Contact Details
La Lucia Public Library	William Campbell Drive, Durban North	031 572 2986

12.4.2 30-Day Authority Review Period

Copies of the Draft BAR were also provided to the key regulatory and commenting authorities mentioned in Section 12.3.1.

Proof of notification to commenting authorities of the review period and all proof of deliveries of the Draft BAR to all organs of states will be available in the Final BAR.

12.4.3 Notification of Draft BAR review period

BIDs, which included a Reply Form, were distributed again via email to IAPs as well as previously registered IAPs contained in the IAP Database. BIDs contained the details of the Draft BAR review period and public meeting.

Site notices were placed again at the locations in **Table 9**. A newspaper advert will be placed in The Northglen News on 13 November 2018. Notification took place from 12 to 13 November 2018. Proof of notification will be provided in the Final BAR to be submitted to KZN EDTEA.

12.4.4 Public Meeting

A public meeting will only be held for the project to discuss the BA Process if a registered IAP requests a meeting. The request for a public meeting was included on all notices (BIDs, site notices and adverts). If a meeting is requested, all registered IAPs will be notified of the meeting details. The minutes and attendance registers of these meetings will be provided in the Final BAR if taken place.

12.5 Comments and Responses Report

The CRR, which summarises the salient issues raised by IAPs and the project team's response to these matters, is contained in **Appendix 6E**. The issues listed in the CRR were identified from completed Reply Forms, emails, and other correspondence received to date. The CRR will be updated in the Final BAR, after the 30-day review period.

12.6 Decision on the Final BAR

The Final BAR will be submitted to KZN EDTEA after the 30-Day review period reflecting the incorporation of comments received. The EAP will inform all registered IAPs of the decision on the Final BAR by KZN EDTEA, of which KZN EDTEA have 107 days to make a decision from the receipt of the Final BAR.

13 Environmental Attributes

The environmental attributes associated with the alternative pipeline routes identified focusing on the geographical, physical, biological, social, economic and cultural aspects of the environment. The following significant environmental attributes are focused on in this report:

1. Geology;
2. Terrestrial Ecology;
3. Air Quality;

4. Noise;
5. Aesthetic Qualities;
6. Socio – Economic Environment;
7. Transportation;
8. Existing Infrastructure;
9. Historical and Cultural Features; and
10. Watercourses.

The sensitive environmental features, attributes and aspects, for which mitigation measures are included in the BAR and EMPr, are further discussed in Section 18.1.

13.1 Geology

The geology of a site can play a fundamental role in better understanding the soil types prevalent within the site and how the different geological zones may directly influence the functioning of the freshwater ecosystems. The study site is located on the Berea Red sands lithology. The Berea Red sands are common along coastlines, where the soils have a distinct red colour and are sandy in composition. Generally, the Berea Red is a weakly structured and well-drained soil. The Berea Red formation, in this context, is underlain by clayey sands that can often be associated with seasonal perched water tables.

13.2 Terrestrial Ecology

13.2.1 Flora

13.2.1.1 Biome and Vegetation

The study area falls within the Forest and Indian Ocean Coastal belt biomes (**Figures 10** and **11**). Forest biomes consist of primarily evergreen plants and are characterised by trees that form a continuous canopy. It is the smallest biome in South Africa and occurs in numerous small patches in the eastern and southern parts of South Africa. The proposed stormwater and sewer infrastructure alternatives traverse two vegetation types, namely the KwaZulu-Natal Coastal Belt Grassland and KwaZulu-Natal Dune Forests: East Coast Dune Forest (**Figures 12** and **13**).

Figure 10: Biome map for the proposed stormwater infrastructure alternatives

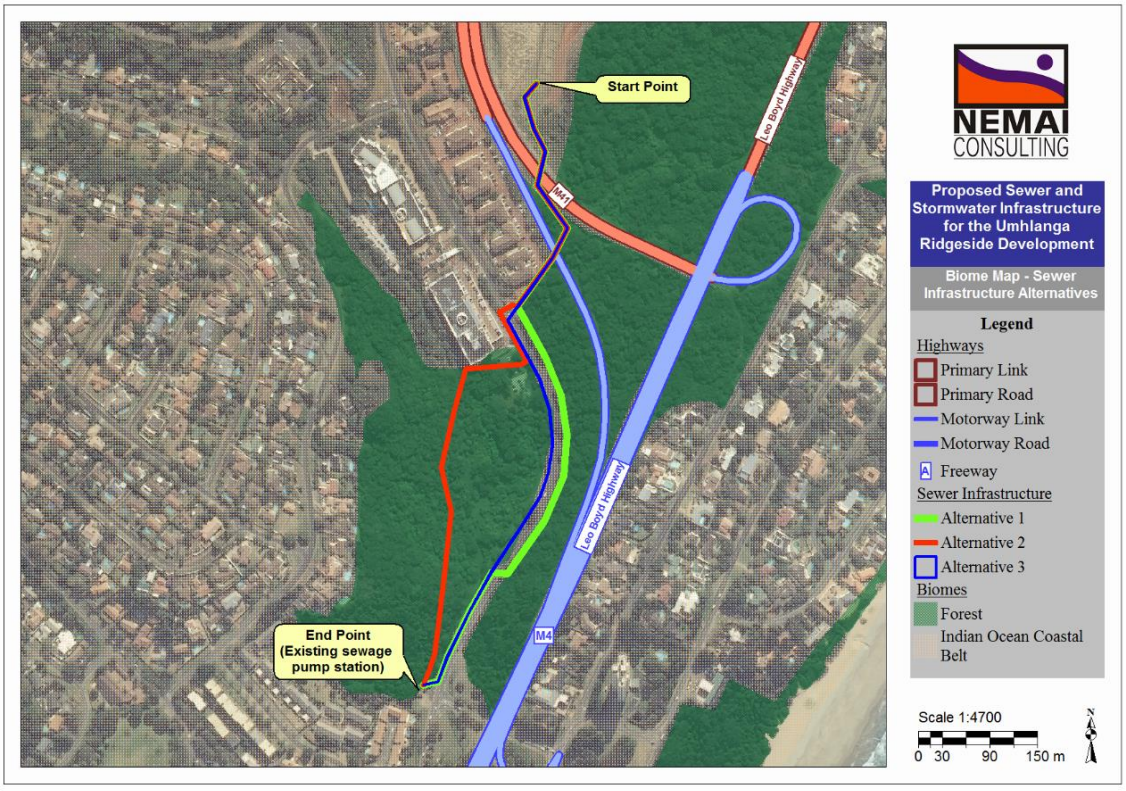


Figure 11: Biome map for the proposed sewer infrastructure alternatives

Figure 12: Vegetation type map for the proposed stormwater infrastructure alternatives

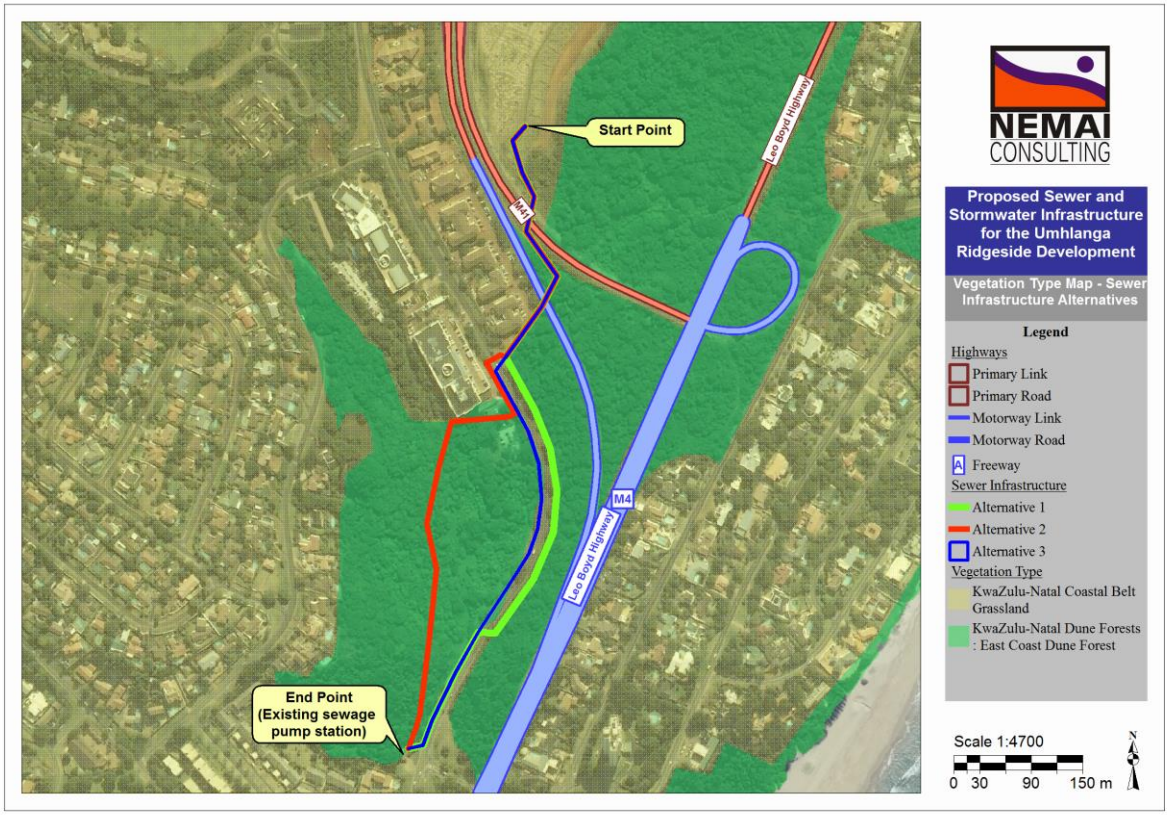


Figure 13: Vegetation type map for the proposed sewer infrastructure alternatives

KwaZulu-Natal Coastal Belt Grassland

This vegetation type is KwaZulu-Natal Province. It occurs in long and in places broad coastal strip along the KwaZulu-Natal coast, from near Mtunzini in the north, via Durban to Margate and just short of Port Edward in the south. It is highly dissected undulating coastal plains which presumably used to be covered to a great extent with various types of subtropical coastal forest (the remnants of one of which are described as Northern Coastal Forest). Some primary grassland dominated by *Themeda triandra* still occurs in hilly, high-rainfall areas where pressure from natural fire and grazing regimes prevailed. At present the KwaZulu – Natal Coastal Belt is affected by an intricate mosaic of very extensive sugarcane fields, timber plantations and coastal holiday resorts, with interspersed secondary Aristida grasslands, thickets and patches of coastal thornveld (Mucina and Rutherford, 2006).

This vegetation type is listed as endangered, with a national conservation target of 25%. Only very small part is statutory conserved in Ngoye, Mbumbazi and Vernon Crookes Nature Reserves. About 50% is transformed for cultivation, by urban sprawl and for road-building. Alien plant species include *Chromolaena odorata, Lantana camara, Melia azedarach* and *Solanum mauritianum* (Mucina and Rutherford, 2006).

KwaZulu-Natal Dune and Forests: East Coast Dune Forest

This vegetation type is included in Northern Coastal Forest and Mucina & Rutherford (2006) described it is occurring in KwaZulu-Natal and (to a very small extent) Eastern Cape Provinces: It is found especially along the seaboards of Indian Ocean of KwaZulu-Natal Province and particularly well-developed in Maputaland. Few patches of the dune forest also occur on the Wild Coast of Transkei (Eastern Cape Province). Beyond South Africa these forests occur throughout the Mozambican seaboard as far as southern Tanzania. Species-rich, tall/medium-height subtropical coastal forests occur on coastal (rolling) plains and stabilised coastal dunes. Forests of the coastal plains are dominated by *Drypetes natalensis, Englerophytum natalense, Albizia adianthifolia, Diospyros inhacaensis*, etc.

The low-tree and shrubby understoreys are species-rich and comprise many taxa of (sub) tropical provenience. On dunes, these forests have well tree, shrub and herb layers. *Mimusops caffra, Sideroxylon inerme, Dovyalis longispina, Acacia kosiensis* and *Psydrax obovata* subsp. *obovata* are the most common constituents of the tree layer. *Brachylaena discolour* var. discolour, *Chrysanthemoides monilifera* subsp. *rotundata*, *Carissa bispinosa* subsp. *bispinosa*, *Euclea natalensis, E. racemosa, Eugenia capensis, Gymnosporia nemorosa, Kraussia floribunda, Peddiea africana, Strelitzia nicolai* and *Dracaena aletriformis* are frequent in the understorey. The herb layer usually contains by *Asystasia gangetica, Isoglossa woodii, Microsporum scolopendria, Zamiculas zamiifolia* and *Oplismenus hirtellus*. Herbaceous vines and woody climbers (*Acacia kraussiania, Artabotrys monteiroae, Delbergia armata, Landolphia kirkii, Monothotaxis caffra, Rhoicissus tomentose, Rhus nebulosa, Scutia myrtina, Uvaria caffra, Gloria superba,* etc.) are important structural determinants in these forests (Mucina and Rutherford, 2006).

There are eight subtypes (Scott-Shaw, 2011b):

- KwaZulu-Natal Coastal Forests : Dukuduku Moist Coastal Lowlands Forest
- KwaZulu-Natal Coastal Forests : Maputaland Dry Coastal Lowlands Forest
- KwaZulu-Natal Coastal Forests : Maputaland Mesic Coastal Lowlands Forest
- KwaZulu-Natal Coastal Forests : Maputaland Moist Coastal Lowlands Forest
- KwaZulu-Natal Coastal Forests : Southern Mesic Coastal Lowlands Forest
- KwaZulu-Natal Coastal Forests : Southern Moist Coastal Lowlands Forest
- **KwaZulu-Natal Dune Forests : East Coast Dune Forest**
- KwaZulu-Natal Dune Forests : Maputaland Dune Forest

According to Jewitt (2011), the KwaZulu-Natal Dune Forests: East Coast Dune Forest vegetation type is listed as **critically endangered**.

13.2.1.2 Terrestrial Threatened Ecosystems

The South African National Biodiversity Institute (SANBI), in conjunction with the Department of Environmental Affairs (DEA), released a draft report in 2009 entitled “Threatened Ecosystems in South Africa: Descriptions and Maps”, to provide background information on the above List of Threatened Ecosystems (SANBI, 2009). The purpose of this report was to present a detailed description of each of South Africa’s ecosystems and to determine their status using a credible and practical set of criteria. The following criteria were used in determining the status of threatened ecosystems:

- Irreversible loss of natural habitat;
- Ecosystem degradation and loss of integrity;
- Limited extent and imminent threat;
- Threatened plant species associations;
- Threatened animal species associations; and
- Priority areas for meeting explicit biodiversity targets as defined in a systematic conservation plan.

In terms of section 52(1) (a), of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004), a national list of ecosystems that are threatened and in need of protection was gazetted on 9 December 2011 (GN 1002 (Driver *et. al* 2004). The list classified all threatened or protected ecosystems in South Africa in terms of four categories; Critically Endangered (CR), Endangered (EN), Vulnerable (VU), or Protected. The purpose of categorising these ecosystems is to prioritise conservation areas in order to reduce the rates of ecosystem and species extinction, as well as preventing further degradation and loss of structure, function, and composition of these ecosystems. It is estimated that threatened ecosystems make up 9.5% of South Africa, with critically endangered and endangered ecosystems accounting for 2.7%, and vulnerable ecosystems 6.8% of the land area. It is therefore vital that Threatened Terrestrial Ecosystems inform proactive and reactive

conservation and planning tools, such as Biodiversity Sector Plans, municipal Strategic Environmental Assessments (SEAs) and Environmental Management Frameworks (EMFs), EIAs and other environmental applications (Mucina *et al*. 2006).

According to the data sourced from South African National Biodiversity Institute (SANBI); the *critically endangered* Northern Coastal Grasslands was listed as the only terrestrial threatened ecosystem recorded in the proposed development area (SANBI, 2009) as indicated in **Figures 14** and **15** below.

The Northern Coastal Grasslands terrestrial threatened ecosystem must receive highest priority for protection, whether in the planning of new conservation areas, or control of development and land use change. This threatened ecosystem is found in the Indian Ocean Coastal Belt and Forest biomes and is distributed in KwaZulu-Natal Province. It extends from KwaDukuza (2931AD), Verulam (2931CA) and Durban (2930DD) and this Ecosystem is delineated by the Indian Ocean in the east, inland to within 1 km of the coast and running parallel to the coast following an approximate altitude of up to 150m. The key biodiversity features include two millipede species including *Centrobolus anulatus* and *Doratogonus cristulatus*; two plant species including *Kniphofia littoralis* and *Kniphofia pauciflora*; two reptile species including *Bradypodion melanocephalum* and *Scelotes inornatus*; and six vegetation types including KwaZulu-Natal Dune Forest, Mangrove Forest, Maputuland Coastal Belt and KwaZulu-Natal Coastal Belt. Less than 1% of the ecosystem is protected in Bluff Nature Reserve, Beachwood Mangroves Nature Reserve and Umhlanga Lagoon Nature Reserve (Goodman, 2007).

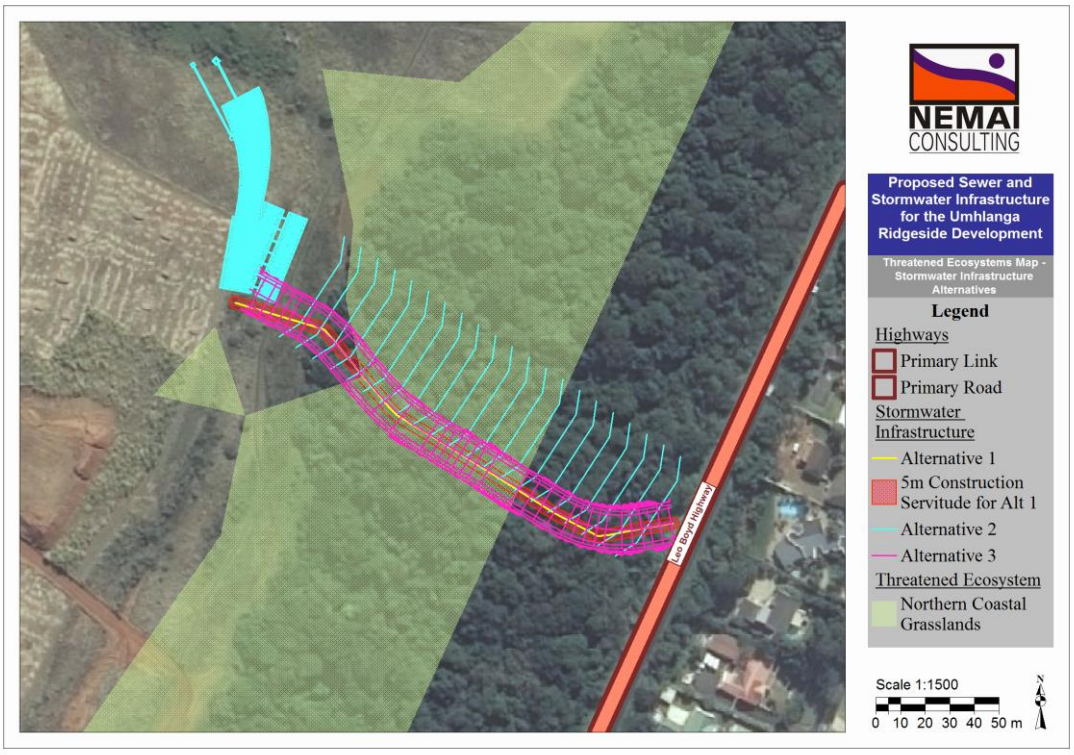


Figure 14: Terrestrial Threatened Ecosystems for the proposed stormwater infrastructure alternatives

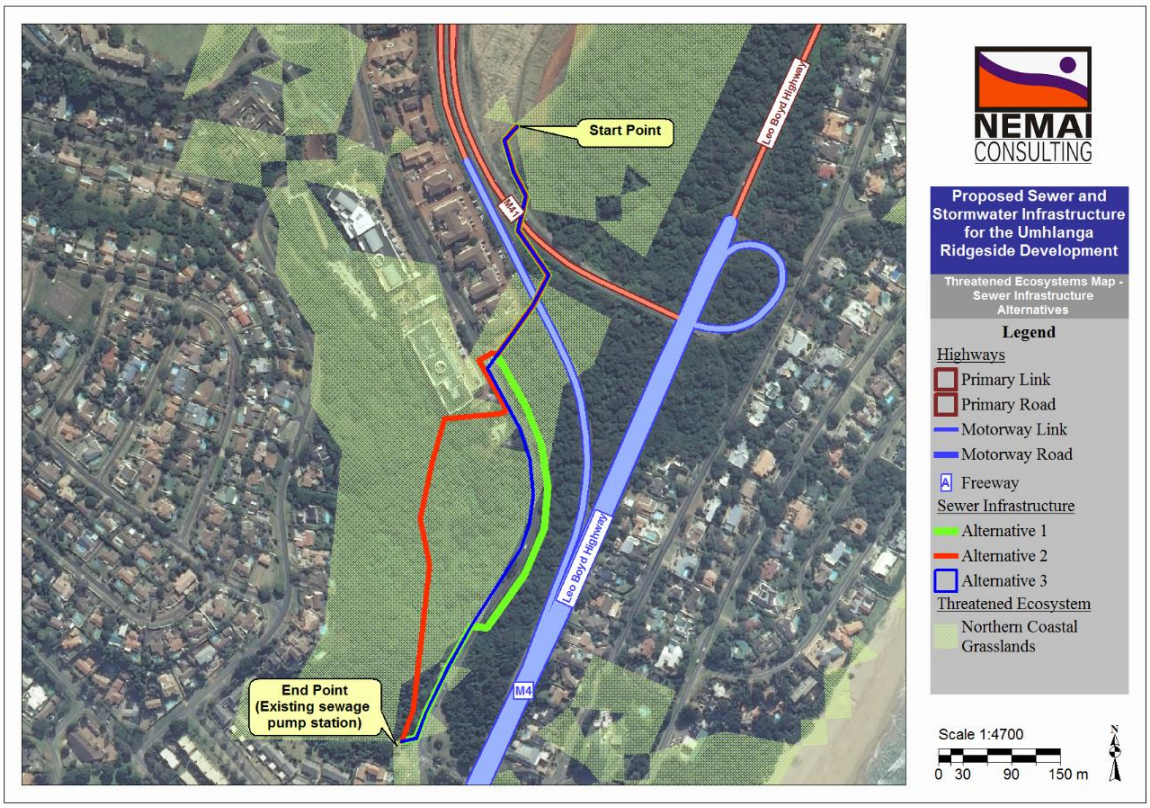


Figure 15: Terrestrial Threatened Ecosystems for the proposed sewer infrastructure alternatives

13.2.1.3 Critical Biodiversity Areas (CBA)

CBAs are areas required to meet biodiversity targets for ecosystems, species and ecological processes, as identified in a systematic biodiversity plan. The CBAs can be divided into two subcategories, namely Irreplaceable and Optimal (Ezemvelo KZN Wildlife, 2016).

The **CBA: Irreplaceable Areas** are identified as having an Irreplaceability value of 1, these Planning Units (PU's) represent the only localities for which the conservation targets for one or more of the biodiversity features contained within can be achieved, i.e. there are no alternative sites available. In the Terrestrial Systematic Conservation Assessment (SCA), this category was previously referred to as a Biodiversity Priority 1 Area (KZN CBA Irreplaceable version 01022016, 2016). CBA: Irreplaceable Areas are made up of up to three subcategories; namely CBA: High Irreplaceable Areas (In the Terrestrial SCA, this category was previously referred to as a Biodiversity Priority 2 Area), CBA: Irreplaceable Linkages and Critical Biodiversity Area: Expert Input (Ezemvelo KZN Wildlife, 2016).

According to the Ezemvelo KZN Wildlife (2016), all the proposed infrastructure alternatives (both sewer and stormwater) fall within the KZN CBA: Irreplaceable Areas (**Figures 16** and **17**).

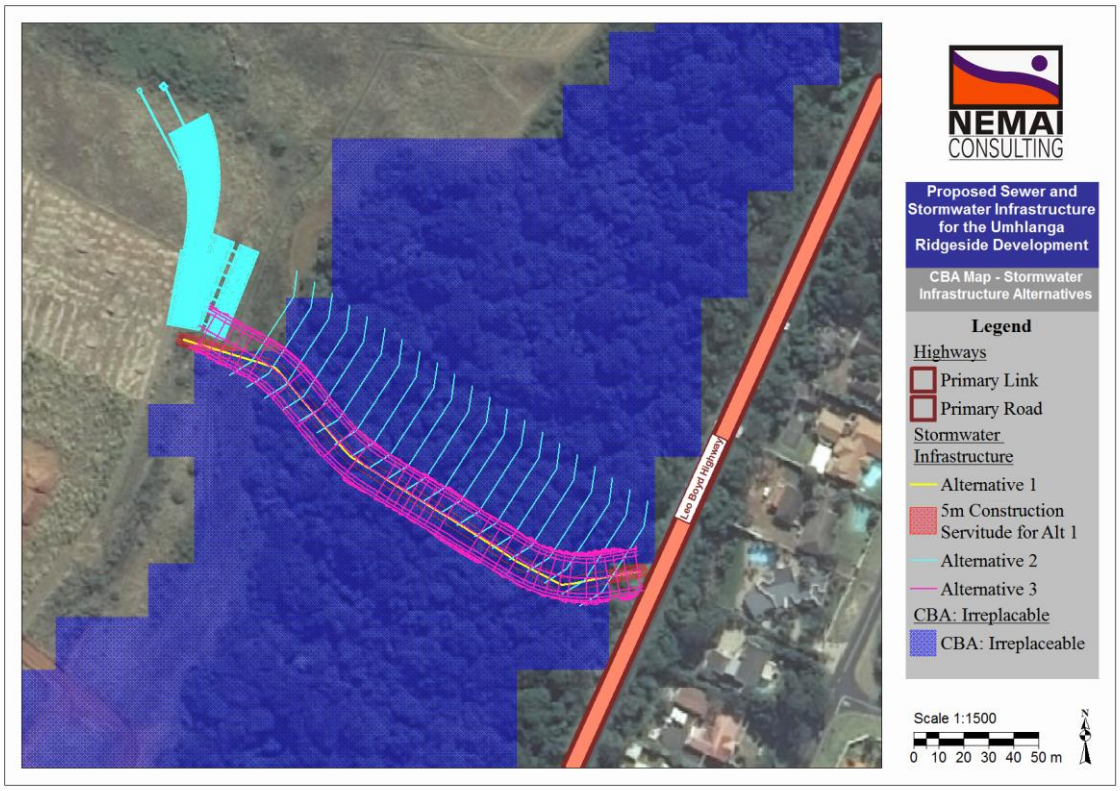


Figure 16: KZN CBA: Irreplaceable areas for the proposed stormwater infrastructure alternatives

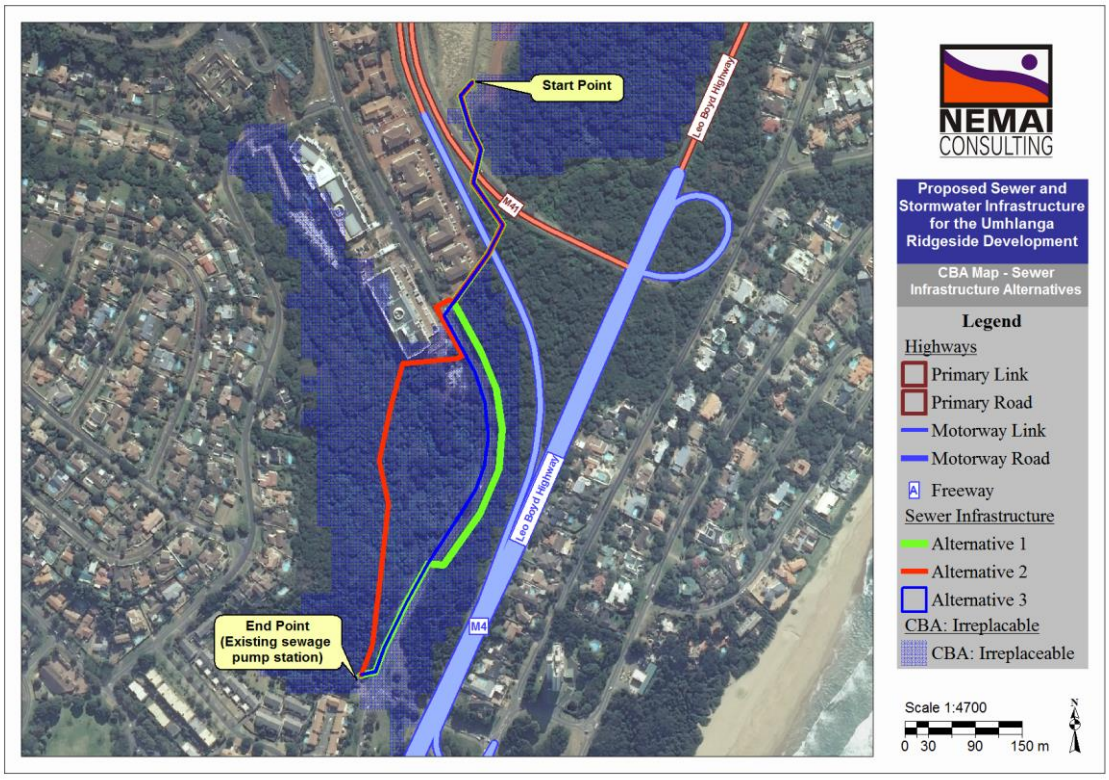


Figure 17: KZN CBA: Irreplaceable areas for the proposed sewer infrastructure alternatives

CBA: Optimal Expert Input are areas identified by local experts as representing areas of biodiversity importance. These areas must have been taken through a workshop exercise to confirm their identification and selection. These areas can be categorized as CBA: Optimal based on confidence in the data, condition and threat status (Ezemvelo KZN Wildlife, 2016). According to the Ezemvelo KZN Wildlife (2016), all the proposed infrastructure alternatives (both sewer and stormwater) do not fall within the KZN CBA: Optimal Areas.

13.2.1.4 Ecological Support Areas (ESAs)

ESAs are areas required to support and sustain the ecological functioning of CBAs. For terrestrial and aquatic environments, these areas are functional but are not necessarily pristine natural areas. They are however required to ensure the persistence and maintenance of biodiversity patterns and ecological processes within the CBAs, and which also contributes significantly to the maintenance of Ecological Infrastructure (EI) (Ezemvelo KZN Wildlife, 2016). ESAs are made up of up to four subcategories; namely Ecological Support Areas (SCA), ESA: Expert input, ESA: Species Specific and ESA: Corridors (Ezemvelo KZN Wildlife, 2016).

According to the Ezemvelo KZN Wildlife (2016), all the proposed infrastructure alternatives (both sewer and stormwater) do not fall within any of the KZN ESA Areas.

13.2.1.5 Durban Metropolitan Open Space System (D'MOSS)

The proposed infrastructure alternatives fall within areas denoted as a Durban Metropolitan Open Space System (D'MOSS) area (**Figures 18** and **19**).

D'MOSS is a network of natural open spaces, defined by the EMM as critical for the ecosystem goods and services that they supply to the residents of the municipal area. D'MOSS aims to conserve local biodiversity and to ensure the supply of environmental services for current and future generations.

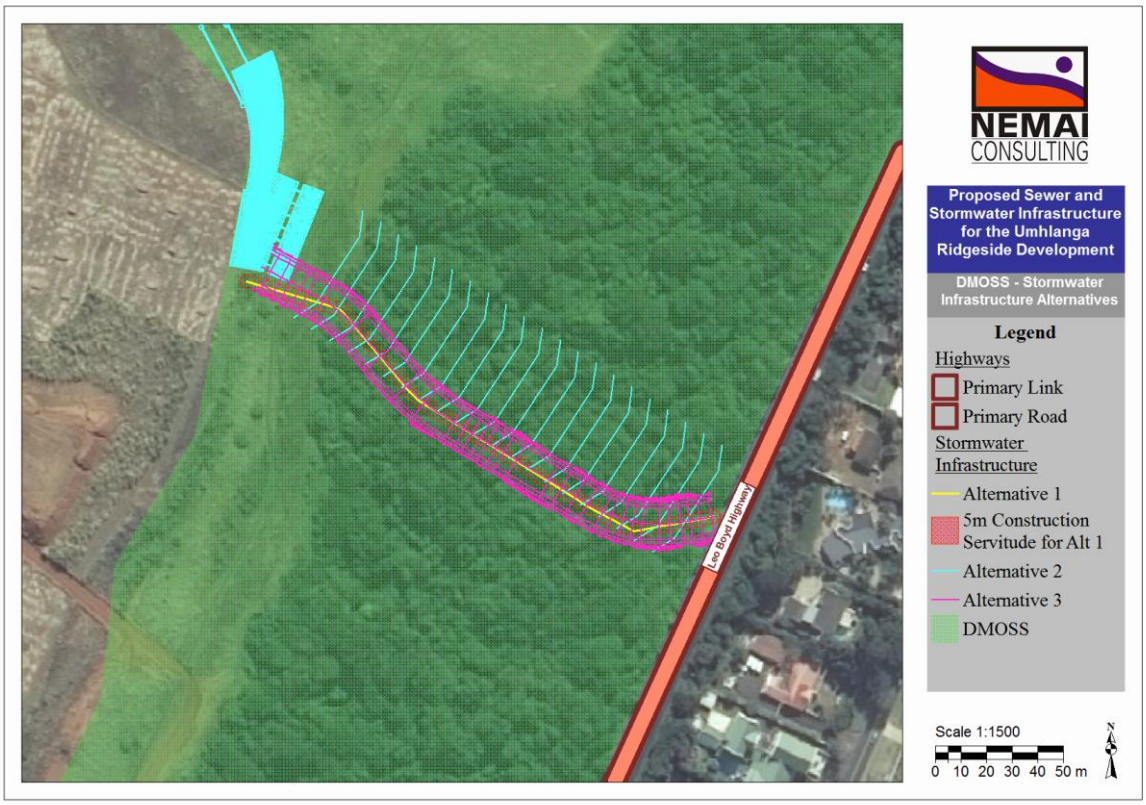


Figure 18: DMOSS for the proposed stormwater infrastructure alternatives

Figure 19: DMOSS for the proposed sewer infrastructure alternatives

13.2.1.6 Natural Forest

According to Shackleton (1999), a natural forest is a generally multi-layered vegetation unit dominated by trees (largely evergreen or semi-deciduous), whose combined strata have overlapping crowns (i.e. the crown cover is 75% or more), and where grasses in the herbaceous stratum (if present) are generally rare. Fire does not normally play a major role in forest function or dynamics except at the fringes. According to Scott-Shaw & Escott (2011), the proposed infrastructure alternatives traverse through the KwaZulu-Natal Dune Forest (**Figure 20**), and both Mucina & Rutherford (2006) and SANBI (2012) described this forest as Northern Coastal Forest.

Figure 20: Natural forest in relation to the proposed stormwater and sewer infrastructure alternatives

The forests near the coast (such as KwaZulu Natal Coastal Forest and Transkei Coastal Forest types) have been under most pressure due to the expansion of farmland and developments. The National Forests Act of 1998 (as amended) provides the strongest and most comprehensive legislation and mandate for the protection of all natural forests in South Africa. Section 7 of the Act prohibits the cutting, disturbance, destruction or removal of any indigenous living or dead tree in a forest without a licence. The Act is enforced by DAFF. This patchy natural forest community comprises primarily *Albizia adianthifolia, Ekebergia capensis, Trichilia dregeana* and *Brachylaena discolor* as the dominant woody species and this was confirmed by a Forest management and restoration report compiled by Newtown landscape Architects cc.

13.2.1.7 Protected Areas

The aim of the National Environmental Management: Protected Areas Act (Act No. 57 of 2003) is to provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and natural seascapes. The purpose of a Protected Environment is amongst others to protect a specific ecosystem outside a special nature reserve world heritage site or nature reserve and also to ensure the use of the natural resources in the area is sustainable.

The study area does not fall within or near any protected area (**Figure 21**).

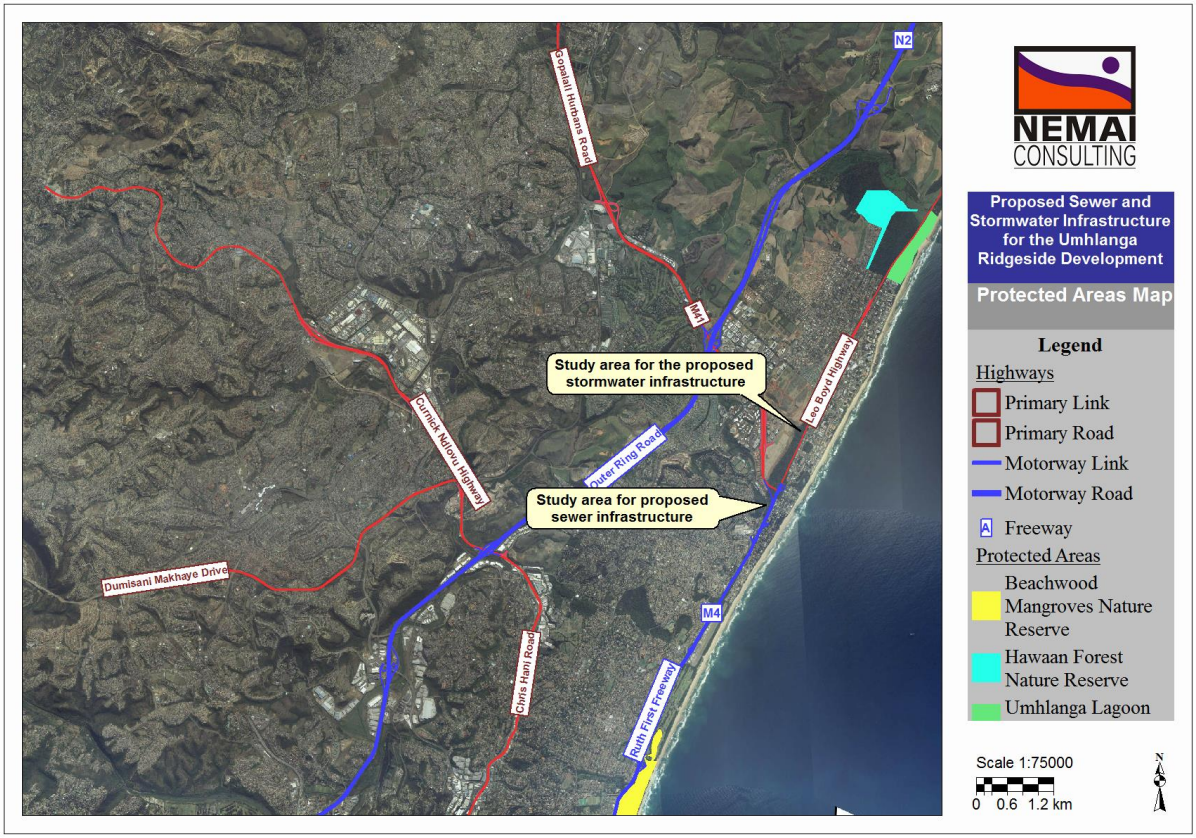


Figure 21: Protected area map in relation to the study area

13.2.1.8 Plant Species of Conservation Concern

The proposed infrastructure alternatives are located within 2931CA and 2931CC quarter degree squares in terms of the 1:50 000 grid of South Africa. South African National Biodiversity Institute (SANBI) uses this grid system as a point of reference to determine any Red Data plant species or any species of conservation importance occurring in South Africa. This can be used to determine the list of species which may potentially occur within an area. **Table 11** provides details on the Red Data plant species which have been recorded in 2931CA and 2931CC grid cells. The definitions of the conservation status are provided in **Table 12**. According to the information sourced from EKZNW, "*Using a 500m buffer around the proposed pipelines, no species show up in our database*". Due to the fact that threatened species have

historically been noted in the area, it is imperative that, during the construction phase, detailed searches for these rare/threatened and protected species are made during the appropriate time of year when plants are likely to be more noticeable.

Table 11: Potential threatened plant species recorded in grid cells 2931CA

Family	Species	Threat status	Growth forms
Amaryllidaceae	*Crinum macowanii* Baker	Declining	Geophyte
Anacardiaceae	*Searsia harveyi* (Moffett) Moffett	NT	Shrub
Apocynaceae	*Mondia whitei* (Hook.f.) Skeels	EN	Climber
Arecaceae	*Raphia australis* Oberm. & Strey	VU	Tree
Asphodelaceae	*Aloe linearifolia* A.Berger	NT	Herb
Asphodelaceae	*Aloe thraskii* Baker	NT	Shrub
Asphodelaceae	*Kniphofia littoralis* Codd	NT	Herb
Asphodelaceae	*Kniphofia pauciflora* Baker	CR	Herb
Asteraceae	*Cineraria atriplicifolia* DC.	VU	Herb
Asteraceae	*Cineraria pinnata* O.Hoffm. ex Schinz	NT*	Herb
Celastraceae	*Elaeodendron transvaalense* (Burtt Davy) R.H.Archer	NT	Shrub
Celastraceae	*Elaeodendron croceum* (Thunb.) DC.	Declining	Tree
Fabaceae	*Lotononis dichiloides* Sond.	CR PE	Shrub
Fabaceae	*Indigofera hybrida* N.E.Br.	VU	Herb
Gentianaceae	*Sebaea scabra* Schinz	NT	Herb
Hypoxidaceae	*Hypoxis hemerocallidea* Fisch., C.A.Mey. & Avé-Lall.	Declining	Geophyte
Lauraceae	*Cryptocarya latifolia* Sond.	Declining	Tree
Malvaceae	*Hermannia sandersonii* Harv.	VU	Shrub
Myrsinaceae	*Rapanea melanophloeos* (L.) Mez	Declining	Tree
Orchidaceae	*Disperis woodii* Bolus	Declining	Geophyte
Orchidaceae	*Eulophia speciosa* (R.Br. ex Lindl.) Bolus	Declining	Geophyte
Orchidaceae	*Zeuxine africana* Rchb.f.	EN*	Geophyte
Orobanchaceae	*Hyobanche fulleri* E.Phillips	CR	Herb
Passifloraceae	*Adenia gummifera* (Harv.) Harms var. *gummifera*	Declining	Climber
Rhizophoraceae	*Cassipourea gummiflua* Tul. var. *verticillata* (N.E.Br.) J.Lewis	VU*	Tree
Rhizophoraceae	*Cassipourea malosana* (Baker) Alston	Declining	Shrub
Stangeriaceae	*Stangeria eriopus* (Kunze) Baill.	VU	Geophyte
Vitaceae	*Cyphostemma flaviflorum* (Sprague) Desc.	NT	Climber
Zamiaceae	*Encephalartos ghellinckii* Lem.	VU	Shrub

Note: CR PE=Critically Endangered (Possibly Extinct); CR= Critically Endangered; EN=Endangered, VU=Vulnerable, NT=Near Threatened

Table 12: Definitions of Red Data status (Raimondo *et al.* 1999)

Symbol	Status	Description
CR PE	Critically Endangered (Possibly Extinct)	Critically Endangered (Possibly Extinct) taxa are those that are, on the balance of evidence, likely to be extinct, but for which there is a small chance that they may be extant. Hence they should not be listed as Extinct until adequate surveys have failed to record the taxon.
CR	Critically Endangered	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the five International Union for Conservation of Nature (IUCN) criteria for Critically Endangered, and is therefore facing an extremely high risk of extinction in the wild.
EN	Endangered	A taxon is Endangered when the best available evidence indicates that it meets any of the five IUCN criteria for Endangered, and is therefore facing an extremely high risk of extinction in the wild.
VU	Vulnerable	A taxon is Vulnerable when the best available evidence indicates that it meets any of the five IUCN criteria for Vulnerable and it is therefore considered to be facing a high risk of extinction in the wild.
NT	Near Threatened	A taxon is Near Threatened when available evidence indicates that it is close to meeting any of the five IUCN criteria for Vulnerable and it is therefore likely to qualify for a threatened category in the near future.
	Declining	A taxon is Declining when it does not meet any of the five IUCN criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline in the population.

13.2.2 Fauna

13.2.2.1 Mammals

The potential mammal species that could be found in the study area are those which have been recorded in the grid cells 2931CA and 2931CC (ADU, 2017) and are listed in **Table 13** below. According to this list, there are several mammal species of conservation concern known to occur in the region. However, species such as African Buffalo, Cheetah, Nyala, Bushbuck and Plains Zebra were excluded from the assessment as they are mostly restricted to the conservation areas. Due to study area situated near human settlements and confined to forest habitat, the list is likely to overestimate the occurrence of mammal species in the area and thus should be viewed with a degree of caution.

Table 13: Potential mammal species recorded in grid cells 2931CA and 2931CC (ADU, 2017)

Family	Genus	Species	Common name	Red List category	Atlas region endemic
Balaenopteridae	*Megaptera*	*novaeangliae*	Humpback Whale	Near Threatened	
Bathyergidae	*Cryptomys*	*hottentotus*	Southern African Mole-rat	Least Concern	Yes
Bovidae	*Aepyceros*	*melampus*	Impala	Least Concern	Yes
Bovidae	*Cephalophus*	*natalensis*	Red Duiker	Least Concern	Yes
Bovidae	*Philantomba*	*monticola*	Blue Duiker	Vulnerable	Yes
Bovidae	*Sylvicapra*	*grimmia*	Bush Duiker	Least Concern	Yes
Bovidae	*Syncerus*	*caffer*	African Buffalo	Least Concern	Yes
Bovidae	*Tragelaphus*	*angasii*	Nyala	Least Concern	Yes
Bovidae	*Tragelaphus*	*scriptus*	Bushbuck	Least Concern	Yes
Cercopithecidae	*Cercopithecus*	*pygerythrus*	Vervet Monkey	Least Concern	
Chrysochloridae	*Amblysomus*	*hottentotus*	Hottentot Golden Mole	Data Deficient	Yes
Delphinidae	*Stenella*	*attenuata*	Pantropical Spotted Dolphin	Data Deficient	
Delphinidae	*Tursiops*	*truncatus*	Bottlenose Dolphin	Data Deficient	
Emballonuridae	*Taphozous*	*mauritianus*	Mauritian Tomb Bat	Least Concern	Yes
Equidae	*Equus*	*quagga*	Plains Zebra	Not listed	Yes
Felidae	*Acinonyx*	*jubatus*	Cheetah	Vulnerable	Yes
Herpestidae	*Atilax*	*paludinosus*	Marsh Mongoose	Least Concern	Yes
Herpestidae	*Herpestes*	*sanguineus*	Slender Mongoose	Least Concern	Yes
Herpestidae	*Ichneumia*	*albicauda*	White-tailed Mongoose	Least Concern	Yes
Herpestidae	*Mungos*	*mungo*	Banded Mongoose	Least Concern	Yes
Hystricidae	*Hystrix*	*africaeaustralis*	Cape Porcupine	Least Concern	Yes
Molossidae	*Chaerephon*	*nigeriae*	Nigerian Free-tailed Bat	Not listed	Yes
Molossidae	*Chaerephon*	*pumilus*	Little Free-tailed Bat	Least Concern	Yes
Muridae	*Aethomys*	*ineptus*	Tete Veld Aethomys	Least Concern	Yes
Muridae	*Dasymys*	*incomtus*	Common Dasymys	Near Threatened	Yes
Muridae	*Grammomys*	*dolichurus*	Common Grammomys	Data Deficient	Yes
Muridae	*Lemniscomys*	*rosalia*	Single-Striped Lemniscomys	Data Deficient	Yes

Family	Genus	Species	Common name	Red List category	Atlas region endemic
Muridae	*Mastomys*	*natalensis*	Natal Mastomys	Least Concern	
Muridae	*Mus*	*minutoides*	Southern African Pygmy Mouse	Least Concern	Yes
Muridae	*Otomys*	*angoniensis*	Angoni Vlei Rat	Least Concern	Yes
Muridae	*Rattus*	*norvegicus*	Brown Rat	Least Concern	
Muridae	*Rattus*	*rattus*	Roof Rat	Least Concern	
Mustelidae	*Aonyx*	*capensis*	African Clawless Otter	Least Concern	Yes
Nesomyidae	*Dendromus*	*mystacalis*	Chestnut African Climbing Mouse	Least Concern	Yes
Nycteridae	*Nycteris*	*thebaica*	Egyptian Slit-faced Bat	Least Concern	Yes
Otariidae	*Arctocephalus*	*tropicalis*	Subantarctic Fur Seal	Least Concern	
Procaviidae	*Procavia*	*capensis*	Rock Hyrax	Least Concern	Yes
Pteropodidae	*Epomophorus*	*wahlbergi*	Epomophorus wahlbergi	Least Concern	Yes
Soricidae	*Crocidura*	*cyanea*	Reddish-gray Musk Shrew	Data Deficient	Yes
Soricidae	*Crocidura*	*flavescens*	Greater Red Musk Shrew	Data Deficient	Yes
Soricidae	*Crocidura*	*hirta*	Lesser Red Musk Shrew	Data Deficient	Yes
Suidae	*Potamochoerus*	*porcus*	Red River Hog	Not listed	Yes
Thryonomyidae	*Thryonomys*	*swinderianus*	Greater Cane Rat	Least Concern	
Vespertilionidae	*Neoromicia*	*nanus*	Banana Pipistrelle	Least Concern	Yes
Vespertilionidae	*Neoromicia*	*capensis*	Cape Serotine	Least Concern	Yes
Vespertilionidae	*Pipistrellus*	*hesperidus*	Dusky Pipistrelle	Least Concern	Yes
Vespertilionidae	*Scotophilus*	*dinganii*	Yellow-bellied House Bat	Least Concern	Yes
Viverridae	*Genetta*	*maculata*	Rusty-spotted Genet	Not listed	Yes
Viverridae	*Genetta*	*tigrina*	Cape Genet	Least Concern	Yes

13.2.2.2 Avifauna

The Important Bird and Biodiversity Area (IBA) Programme identifies and works to conserve a network of sites critical for the long-term survival of bird species that are globally threatened, have a restricted range and are restricted to specific biomes/vegetation types. Several Conservation and planning tools were consulted for relevancy for the project and the study area does not fall within any of the IBAs (**Figure 22**).

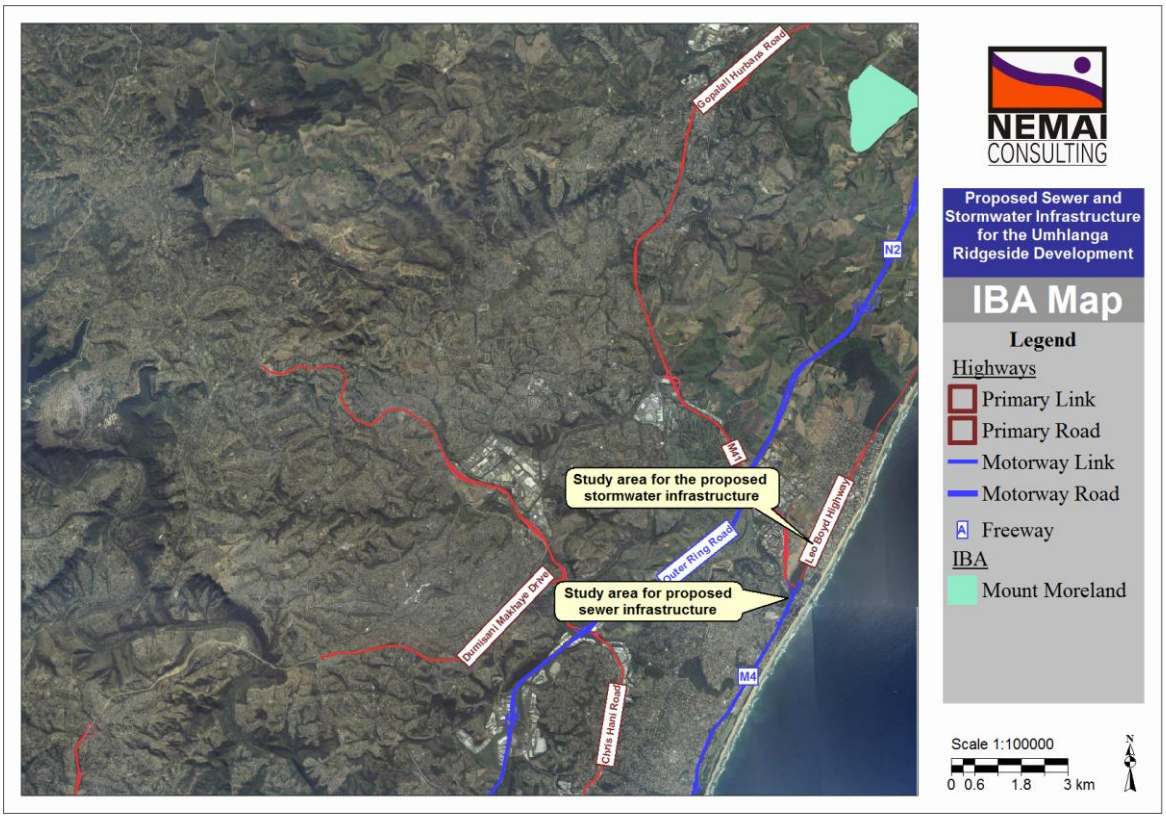


Figure 22: IBA map in relation to the study area

13.2.2.3 Reptiles

The Field Guide to the Snakes and other Reptiles of Southern Africa (Branch, 2001) and South African Red Data Book Reptiles (Branch, 1988) were books used during the field survey. **Table 14** lists reptile species which are recorded in the grid cells 2931CA and 2931CC based on the South African Reptile Conservation Assessment (ADU, 2017). According to the list, species of conservation concern are known to occur in the vicinity of the proposed development routes. According to the data sourced from EKZNW, one reptile species of conservation concern is known to occur in the region, namely *Bradypodion melanocephalum* (KwaZulu dwarf chameleon).

Table 14: Potential reptile species recorded in grid cells 2931CA and 2931CC (SARCA, 2017)

Family	Genus	Species	Subspecies	Common name	Red list category	Atlas region endemic
Agamidae	*Acanthocercus*	*atricollis*	*atricollis*	Southern Tree Agama	Least Concern (SARCA 2014)	
Chamaeleonidae	*Bradypodion*	*melanocephalum*		KwaZulu Dwarf Chameleon	Vulnerable (SARCA 2014)	Yes
Chamaeleonidae	*Chamaeleo*	*dilepis*	*dilepis*	Common Flap-neck Chameleon	Least Concern (SARCA 2014)	
Colubridae	*Crotaphopeltis*	*hotamboeia*		Red-lipped Snake	Least Concern (SARCA 2014)	
Colubridae	*Dasypeltis*	*inornata*		Southern Brown Egg-eater	Least Concern (SARCA 2014)	Yes
Colubridae	*Philothamnus*	*hoplogaster*		South Eastern Green Snake	Least Concern (SARCA 2014)	
Colubridae	*Philothamnus*	*natalensis*	*natalensis*	Eastern Natal Green Snake	Least Concern (SARCA 2014)	
Colubridae	*Philothamnus*	*semivariegatus*		Spotted Bush Snake	Least Concern (SARCA 2014)	
Colubridae	*Thelotornis*	*capensis*	*capensis*	Southern Twig Snake	Least Concern (SARCA 2014)	
Dermochelyidae	*Dermochelys*	*coriacea*		Leatherback Turtle	Endangered (SARCA 2014)	
Elapidae	*Dendroaspis*	*angusticeps*		Green Mamba	Vulnerable (SARCA 2014)	
Elapidae	*Dendroaspis*	*polylepis*		Black Mamba	Least Concern (SARCA 2014)	
Elapidae	*Hydrophis*	*platurus*		Yellow-bellied Sea Snake	Least Concern (SARCA 2014)	
Gekkonidae	*Afroedura*	*pondolia*		Pondo Flat Gecko	Least Concern (SARCA 2014)	Yes
Gekkonidae	*Hemidactylus*	*mabouia*		Common Tropical House Gecko	Least Concern (SARCA 2014)	
Gekkonidae	*Lygodactylus*	*capensis*	*capensis*	Common Dwarf Gecko	Least Concern (SARCA 2014)	
Gerrhosauridae	*Gerrhosaurus*	*flavigularis*		Yellow-throated Plated Lizard	Least Concern (SARCA 2014)	
Lamprophiidae	*Amblyodipsas*	*concolor*		Natal Purple-glossed Snake	Least Concern (SARCA 2014)	Yes
Lamprophiidae	*Amblyodipsas*	*polylepis*	*polylepis*	Common Purple-glossed Snake	Least Concern (SARCA 2014)	
Lamprophiidae	*Aparallactus*	*capensis*		Black-headed Centipede-eater	Least Concern (SARCA 2014)	
Lamprophiidae	*Atractaspis*	*bibronii*		Bibron's Stiletto Snake	Least Concern (SARCA 2014)	
Lamprophiidae	*Boaedon*	*capensis*		Brown House Snake	Least Concern (SARCA 2014)	
Lamprophiidae	*Gonionotophis*	*nyassae*		Black File Snake	Least Concern (SARCA 2014)	
Lamprophiidae	*Lycodonomorphus*	*inornatus*		Olive House Snake	Least Concern (SARCA 2014)	Yes
Lamprophiidae	*Lycodonomorphus*	*rufulus*		Brown Water Snake	Least Concern (SARCA 2014)	
Lamprophiidae	*Lycophidion*	*capense*	*capense*	Cape Wolf Snake	Least Concern (SARCA 2014)	
Lamprophiidae	*Macrelaps*	*microlepidotus*		Natal Black Snake	Near Threatened (SARCA 2014)	Yes

Family	Genus	Species	Subspecies	Common name	Red list category	Atlas region endemic
Lamprophiidae	*Psammophis*	*brevirostris*		Short-snouted Grass Snake	Least Concern (SARCA 2014)	
Leptotyphlopidae	*Leptotyphlops*	*scutifrons*	*conjunctus*	Eastern Thread Snake	Not listed	
Leptotyphlopidae	*Leptotyphlops*	*scutifrons*	*scutifrons*	Peters' Thread Snake	Not listed	
Pelomedusidae	*Pelomedusa*	*subrufa*		Central Marsh Terrapin	Least Concern (SARCA 2014)	
Pelomedusidae	*Pelusios*	*sinuatus*		Serrated Hinged Terrapin	Least Concern (SARCA 2014)	
Scincidae	*Acontias*	*plumbeus*		Giant Legless Skink	Least Concern (SARCA 2014)	
Scincidae	*Panaspis*	*wahlbergii*		Wahlberg's Snake-eyed Skink	Least Concern (SARCA 2014)	
Scincidae	*Scelotes*	*inornatus*		Durban Dwarf Burrowing Skink	Critically Endangered (SARCA 2	Yes
Scincidae	*Scelotes*	*mossambicus*		Mozambique Dwarf Burrowing Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*depressa*		Eastern Coastal Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*striata*		Striped Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*varia*		Variable Skink	Least Concern (SARCA 2014)	
Typhlopidae	*Afrotyphlops*	*bibronii*		Bibron's Blind Snake	Least Concern (SARCA 2014)	
Typhlopidae	*Indotyphlops*	*braminus*		Brahminy Blind Snake	Not listed	
Viperidae	*Bitis*	*arietans*	*arietans*	Puff Adder	Least Concern (SARCA 2014)	
Viperidae	*Causus*	*rhombeatus*		Rhombic Night Adder	Least Concern (SARCA 2014)	

13.3 Air Quality

Current air pollution sources in the region include the following:

- Domestic fuel burning;
- Vehicle tailpipe emissions;
- Vehicle entrainment of dust from paved and unpaved roads;
- Biomass burning (veld fires); and
- Other fugitive dust sources such as wind erosion of exposed areas.

13.4 Noise

Noise in the region emanates primarily from residential and commercial developments and vehicles on the surrounding road network.

13.5 Aesthetic Qualities

The sense of place for the study area can be classified as highly developed with residential and commercial developments (existing and currently being constructed), with the exception of the forest area which is fenced off. The study area is also surrounded by a busy road network (M4) and the ocean (**Figures 23** to **26**). The study area, Umhlanga, is well known as a tourism destination because of the beach.

Figure 23: Commercial and residential developments

Figure 24: Forest area that is fenced off

Figure 25: Surrounding road network

Figure 26: Surrounding forest and ocean

13.6 Socio – Economic Environment

The approved Umhlanga Ridgeside Development is catering for a mixed use development with sea views and open green space which has several positive socio-economic opportunities such as housing, commercial industries and jobs. The study area is located in Umhlanga Ridgeside, the overall development beautifully supplements the Umhlanga Ridge Town Centre and fosters the creation of an integrated, people-centred, mixed-use environment. As an extension of Umhlanga Ridge, Ridgeside will provide a coming together with the existing areas of Gateway, La Lucia Ridge Office Estate, The Manors, Lower La Lucia and Umhlanga Rocks. This area is one of South Africa's fastest growing urban development nodes. Below is a description of the situational analysis for EMM.

13.6.1 Population

In 2001 the population of eThekwini was 3.09 million and has grown at an average annual percentage of 1.13% per annum to reach 3.44 million in 2011 (Statistics South Africa 2011). The forecast in the table below (EMM SDF, 2017/2018-2021/2022) indicates that the population of eThekwini will grow by 175 thousand between 2016 and 2020 when the population total will be 3.85 million.

	2016	2017	2018	2019	2020
Population Total	3,677,575	3,723,435	3,767,939	3,811,167	3,853,278

13.6.2 Municipal Services and Living Conditions Survey

It is important that Municipal decision makers have a clear understanding of the residents' perceptions of their living conditions, their satisfaction with Municipal services and with their neighbourhoods and their satisfaction with the quality of their own lives. In order to provide a scientific basis for assessing the above-mentioned perceptions, the Research and Policy Advocacy Department, formerly Corporate Policy Unit of the eThekwini Municipality undertakes a Municipal Services and Living Conditions Survey annually. This is a municipal wide structured household questionnaire survey.

13.6.3 Social Development Challenges

The challenges posed in EMM include teenage pregnancy, alcohol abuse, HIV/Aids, homelessness, and crime.

13.6.4 Economy

The eThekwini region is the economic powerhouse of KZN and also makes a significant contribution to the South African economy. It is a vital link between the regional economies of Pietermaritzburg (and onward to Gauteng) and Richards Bay, and ranks as the second largest economic Centre with the second most significant industrial region in South Africa. It is a promising global competitor with a world-class manufacturing sector. Umhlanga is also a tourism node.

13.6.5 Housing

The provision of adequate shelter for residents is a priority in the municipality. The table below shows the number and type of dwellings within the municipal area (sourced from the count of dwellings using the 2011 aerial photography):

Type	Sub Type	Dwellings
Formal	Houses	414,357
	Flats	110,225
	Sub Total	524,582
Informal	Single Dwelling ("Shack")	265,542
	Backyard	48,975
	Formal Informal (formal dwellings in informal areas)	3,096
	Sub Total	317,613
Rural	Cluster ("Umuzi")	70,317
	Single Dwelling	26,949
	Formal Informal (Formal dwellings in rural areas)	6,449
	Sub Total	103,715
Total		**945,910**

13.6.6 Infrastructure Delivery

The eThekwini Municipality continues to put significant resources and effort into infrastructure delivery, in order to eradicate existing backlogs.

13.7 Transportation

Noteworthy roads in the immediate study area include Armstrong Avenue, M4, M41 and Umhlanga Rocks Drive (which provides access to the Umhlanga Ridgeside Development).

13.8 Existing Infrastructure

Several structures and infrastructure occur within the study area including, but not limited, to the following:

- Existing bulk water reticulation
- Sewer rising mains and pipelines
- Sewer pump stations
- Fence around the forest
- Stormwater culverts
- Attenuation ponds

13.9 Historical and Cultural Features

Table 15 provides a summary of history of the study area.

Table 15: Description of history of study area

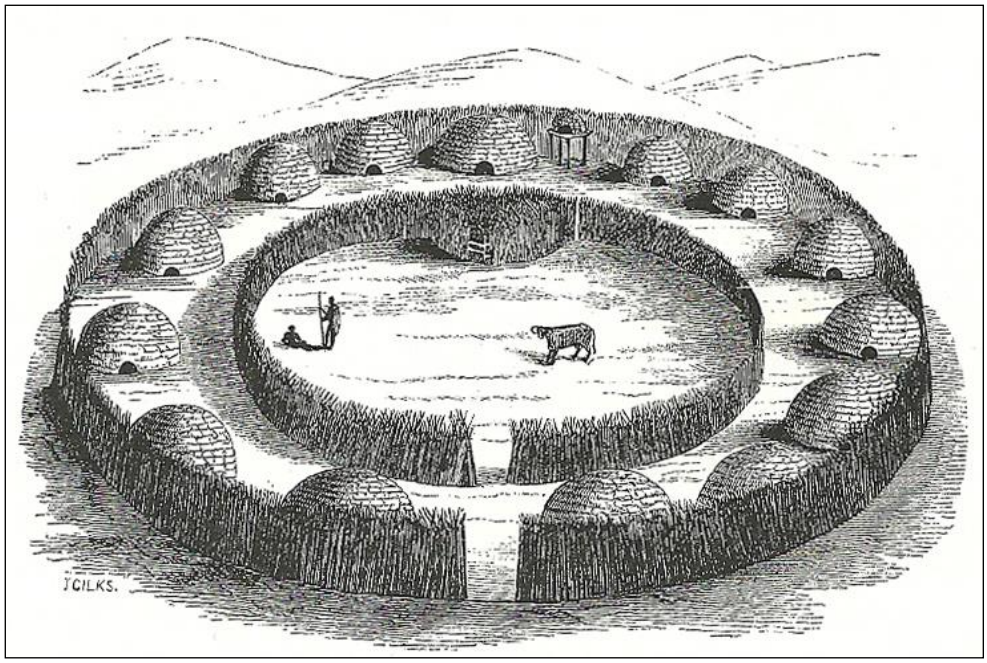
DATE	DESCRIPTION
2.5 million to 250 000 years ago	The Earlier Stone Age (ESA) is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these is known as Oldowan and is associated with more robust flaked tools. It dates to approximately <2 million years ago. The second technological phase is the Acheulian and comprises more refined stone artefacts such as the cleaver and bifacial hand axe. The Acheulian dates back approximately 1.5 million years ago. The HIA conducted at Corobrick by Prins (2014) identified a number of out of context stone artefacts, including an Earlier Stone Age cleaver. This locality is roughly 5 km south-west of the present study area.

DATE	DESCRIPTION
>250 000 to 40 000 years ago	The Middle Stone Age (MSA) is associated with flakes, points and blades manufactured by means of the prepared core technique. This phase is furthermore associated with modern humans and complex cognition (Wadley 2013). Several well-known MSA sites are located in the general region of the study area. Sibudu Cave for example, is located roughly 17 km north of the present study area and has a deep, well-dated Middle Stone Age (MSA) sequence and good organic preservation (Wadley, 2004). The cave was first excavated in 1983 by Aron Mazel of the Natal Museum. Sibudu Cave excavations have yielded an Iron Age occupation directly overlying a long sequence of final Middle Stone Age (MSA) layers dating c. 61 000–26 000 years ago. Older, undated layers contain a Howiesons Poort Industry (Wadley & Jacobs, 2004). Another MSA site from the surrounding landscape is the Umhlatuzana Rock Shelter which is located 30 km south-west of the present study area (Kaplan, 1989). Furthermore, the HIA conducted at Corobrick by Prins (2014) identified a number of out of context stone artefacts that could primarily be identified as Middle Stone Age blades and flakes. This locality is some 5 km south-west of the present study area.
40 000 years ago to the historic past	The Later Stone Age (LSA) is the third archaeological phase identified and is associated with an abundance of very small stone tools known as microliths. One example of a Late Iron Age (LIA) site in the general vicinity of the present study area is Umhlatuzana Rock Shelter, located roughly 17 km to the west. Rescue excavations during 1985 exposed an unexpectedly rich archaeological deposit which reached a depth of 2.5 m. Cultural assemblages from the MSA and LSA were recovered (Kaplan, 1989).
AD 450 – AD 750	The Mzonjani facies of the Kwale Branch of the Urewe Tradition represents the earliest Iron Age phase which can be associated with the study area and its surroundings. The pottery of this facies is characterised by the occurrence of punctates on rim and spaced motifs on the shoulders of the clay vessels. This facies represents the oldest known Iron Age facies from Kwazulu-Natal (Huffman, 2007). The type site was identified during the commencement of road construction some 3.5 km north-west of the study area. (Maggs, 1980). Mzonjani is located on a recently level hilltop that is 2.5 km inland from the coast at La Lucia and 15 km north of Durban. The site is located near Mt

DATE	DESCRIPTION
	Edgecombe. During January 1977, a strip of land 100 m wide was bulldozed clear of sugar-cane and top soil as the first stage in the construction of the National Road 2 freeway northward up the coast from Durban. The consulting engineers, the contractors and the National Roads Department agreed to halt the earthmoving programme for several days while excavations were carried out by a team from the Natal Museum together with other volunteers. Mzonjani is the traditional name for the umndeni or 'ward' in which the site occurs. It was named after a former headman who lived there. The site itself is part of the coastal dune complex of Natal, belonging to the Berea Red Sand Member of the Bluff Formation. It is near the inland margin and consists of red sand and clay to a considerable depth. Early Iron Age (EIA) material was seen for 260 m along the freeway path. Mzonjani, dated to the third and fourth century AD represents the earliest expression of the Iron Age in Kwazulu-Natal. The excavations at Mzonjani produced large ceramic assemblage (Maggs, 1980). The Mzonjani assemblage is by far the largest yet available from Kwazulu-Natal for the period around AD 300, which represents the earliest expression of the EIA in this region. The distribution of EIA material reflects a village of some size. Nothing is known of the above-ground structures but the occupation must have been over a considerable period, perhaps several decades, in view of the quantity of material. The concentration of pottery around certain features could reflect relatively shallow refuse pits into which small quantities of domestic debris were tipped as they silted up with the sandy soil. Or alternatively they could reflect mobility of material, chiefly sherds and charcoal, within the soil profile due to physical, biotic or some other unknown factors. The absence of EIA sherds from exposed areas, which had not actually been bulldozed, suggests that there was some tendency for material to sink beneath the soil surface. However, since there clearly was some pit digging, this factor may also be significant in explaining the occurrence. The poor preservation of organic material means that little can be said about the economy. However, a village of several hectares suggests food production, particularly agriculture, to sustain it. Hunting, trapping and the gathering of shellfish as well as wild plant foods can be surmised on the basis of the local environment. The tuyere fragments from unit 3 and the pieces of slag excavated from 13, both contexts uncontaminated by LIA material, imply small scale iron-smelting on site (Maggs, 1980). The site is located roughly 4.1 km north-east of the present study area.

DATE	DESCRIPTION
AD 650 – AD 750	The Msuluzi facies of the Happy Rest Sub-Branch of the Kalundu Tradition represents another Iron Age phase which can be associated with the study area and surrounding landscape. The pottery of this facies is characterised by broad cross-hatching, blocks of lines on rims as well as complex decoration on the neck and shoulder (Huffman, 2007).
AD 750 – AD 950	The Ndondondwane facies of the Kalundu Tradition is the next Iron Age facies to be identified within the general surroundings of the study area. The key features on the decoration of the ceramics comprise multiple bands of herringbone and cross-hatching in the neck (Huffman, 2007).
AD 950 – AD 1050	The Ntshekane facies of the Kalundu Tradition is the next Iron Age facies to be identified within the general surroundings of the study area. The key features on the decoration of the ceramics from this facies comprise multiple bands of herringbone on sloping necks (Huffman, 2007).
AD 1050 – AD 1500	The Blackburn facies of the Blackburn Branch of the Urewe Tradition represents the next Iron Age phase associated with the study area and surrounding landscape. The pottery of this facies is characterised by rim notching, spaced motifs, chevrons, punctates and appliqué (Huffman, 2007). The type site was excavated between 1968 and 1970 by Davies (1971) and is located roughly 6 km north-east of the present study area. The site of Blackburn (named after the former estate) lies on the crest of a red dune north of the head of the Umhlanga Lagoon, at an altitude of over 75 m. It was discovered by Drs. Beater and Maud, and was reserved from sugar cultivation by Dr. Campbell. Davies conducted a series of excavations at this site between 1968 and 1970 (Davies, 1971). Blackburn seems to have been a hilltop village with large patches of midden down the steep slopes. The houses were probably concentrated on the fairly level crest of the dune. Although two dwellings were identified, the researcher found that the crest of the hill had enough space for at most 19 or 20 adjacent houses of the standard size (5.5 m in diameter) and if a cattle enclosure was present the crest of the dune would have had space for another five houses. No good evidence for terracing was found, although concentrated patches of midden were observed on the slopes, which suggest that dwellings may have been built on terraces. It is therefore possible that additional houses were built on the slopes, which are too steep for building without levelling. The houses

DATE	DESCRIPTION
	whose foundations were excavated appear to have been beehive-huts that were roughly 5.49 m across, with one or more central posts which were estimated to be more than 3.05 m high (Davies, 1971).
AD 1350 – AD 1750	Ongoing research in KwaZulu-Natal has focused on the second phase of the Blackburn sequence, known as Moor Park. During the fourteenth century, the Moor Park farmers were the first to colonize the higher altitude grasslands of South Africa's interior. In doing so they opened up possibilities for greater economic specialization and interdependence, not least because of the impossibility of smelting iron where suitable fuel was lacking. The same lack of timber also encouraged the adoption of stone as a building material (Mitchell and Whitelaw, 2005). The Moor Park facies of the Blackburn Branch of the Urewe Tradition is associated with pottery characterised by punctates, rim notching and appliqué (Huffman, 2007).
c. 1500	During this period, the area today known as Kwazulu-Natal became increasingly populated by black people, and documents dating to as early as 1550 indicate that these residents had generally uniform customs and language (Van Jaarsveld, 1998). While they were not known as Zulu yet, these residents were certainly Nguni. In the words of John Laband (1995:13): "*After about AD 1500 the evidence indicates that the Iron Age people of the Natal-Zululand region were culturally, linguistically and physically the direct ancestors of today's black population, and that their distinctive Nguni-speaking culture had developed within their own region*".
Early 1700s	Oral history relates that, approximately at the beginning of the eighteenth century, a number of other Black groups were living in the Durban area, including the Khanyawo, Nqondo, Thembu and Mpofana. While the Mpofana settled in the present-day Bluff area, the Thembu lived in most of the area where present-day Durban is located today, but south of the uMngeni River. Both these groups were fishermen. However, the Khanyawo, living on the northern side of the uMngeni River, were metal workers and used to trade spears for fish with the neighbouring Thembu (Whitelaw, 1991).
1770s – 1780s	The Thuli moved into the Natal Bay area during this time and established the Thuli Chiefdom in these areas (Whitelaw, 1991).

DATE	DESCRIPTION
1787 - 1828	Shaka kaSenzangakhona, born in 1787, became leader of the small subordinate clan named Zulu, and by the time of his assassination on 24 September 1828 (Laband, 1995) King Shaka had made the Zulu the most powerful kingdom in Africa, a kingdom and people synonymous with a vast piece of South Africa still known today as Zululand and Kwazulu-Natal. As will be shown below, by 1824 the Zulu controlled the Durban area as well.
 ***Figure 27: A 19th century depiction of a typical Zulu umuzi (homestead) (Reader's Digest, 1994:81)***	
1824	Six Englishmen, under the leadership of Henry Francis Fynn and Francis Farewell, established a trading post named Port Natal at present-day Durban. By 1838 the white population of the settlement had reached thirty individuals, and a number of black refugees had settled on a permanent basis at the village as well (Van Jaarsveld, 1998). It is important to note that Laband (1995) indicates that Farewell had communicated with King Shaka of the Zulu for permission to establish the trading post. This indicates that the Zulu kingdom controlled the area known today as Durban at the time.
1828	In 1828, King Shaka ceded to Nathaniel Isaacs the district comprising the site of Durban (Henderson & Pay, 1939).

DATE	DESCRIPTION
1835	In 1835, the settlers decided to lay out the settlement in streets and named the town D'Urban, after Sir Benjamin Durban, the Governor of the Cape Colony (Henderson & Pay, 1939). In the same year, the new king of the Zulu, Dingane, who succeeded after the assassination of Shaka, forbade any white person to cross over the Tugela River (Van Jaarsveld, 1998).
16 December 1837	After the arrival of Dutch speaking trek farmers (*Voortrekkers*) from British controlled Eastern Cape borderlands into the territory of the Zulu as part of the Great Trek, King Dingane attacked their laager at Blood (Ncome) River and was defeated (Laband, 1995).
24 April 1838	Fearing the increasing influence of the white traders at Port Natal, Dingane ordered his army to attack it. By chance, the vessel *Comet* was at anchor of Port Natal, and most of the white families managed to flee to the safety of the ship from where they watched the settlement destroyed (Van Jaarsveld, 1998).
1839 – 1843	With the settlement of Port Natal in ruins, and the threat of Dingane for the time being averted, the Voortrekkers established the Republic of Natalia. Two towns were established by them during this time as well, namely Pietermaritzburg (named after Piet Retief and Gert Maritz) and Congella (in the vicinity of present-day Durban) (Laband, 1995). Alexander Biggar was appointed the first magistrate and Port Natal was properly surveyed for the first time by George Cato. The suburbs of Cato Manor and Cato Ridge were later named in his honour (Erasmus, 2014).
1842	In 1842, after short hostilities which included the Battle of Congella and the Siege of Durban, Captain Smith with a force of 300 men occupied Port Natal (Henderson & Pay, 1939). On 31 May 1844, the territory was formally annexed to the Cape Colony (Erasmus, 2014). In 1845, the first Lieutenant-Governor, Martin West, was appointed (Erasmus, 2014) (Henderson & Pay, 1939).
1848	The first sugar cultivars were imported from Mauritius, and proved to be very successful (www.sahistory.org.za). This resulted in the rapid growth of sugar cane farming in the surroundings of present-day Durban.

DATE	DESCRIPTION
1854	On 15 May 1854, the town of Durban was proclaimed a Borough and George Cato became the first mayor (Henderson & Pay, 1939) (Erasmus 2014).
1860	The system of indenture was approved by governments in India and Britain, endorsed by Natal's colonial legislature, and financed in part by the sugar cane planters. Beginning with the 342 Indians who came on board the Truro on 16 November 1860, a total of 152,641 indentured Indian workers arrived in Natal between 1860 and 1911 (Vahed, 2012).
1865 possibly remove.	The Umgeni Sugar, Coffee and Produce Company Limited was established in 1865 "*...to exploit the large sugar plantation of Sea Cow Lake, just north of Durban.*" (Beinart et.al, 1986). The factory of this company was in Newlands on the northern bank of the uMngeni River and could be seen from Reservoir Hills (South African Sugar Journal, 1981).
11 February 1871	John Langalibalele Dube was born at the Inanda Mission of the American Zulu Mission (AZM). He was the president of the South African Native National Congress (which later developed into the African National Congress) between 1912 and 1917 (www.sahistory.co.za). Although Dube travelled widely, a significant portion of his life was spent at Inanda, roughly 14 km north-west of the present study area.
1879	The Anglo-Zulu War took place during this year. The Durban area would have seen a marked increase in movements of troops and supplies from the harbour to areas further north as well as the establishment of defensive works to protect the settlement from potential Zulu attacks, including ones at Verulam and New Germany (see Laband and Thompson, 1983). However, no skirmishes or battles associated with the war took place anywhere close to the present study area.
1880s - 1890s	After suffering financial bankruptcy in his early years, the early settler and sugar baron Marshall Campbell worked his way up in the Natal sugar industry during the 1880s and 1890s by consolidating central milling operations at Mount Edgecombe. He founded his company Natal Estates Ltd in London in 1895. This company eventually bought out most of the neighbouring sugar estates such as Blackburn, Saccharine Hill, Milkwood Kraal, Effingham and Umtata (Hughes, 2011).
1899 – 1902	The South African War was fought between Great Britain and the Boer republics of the Zuid-Afrikaansche Republiek and Orange Free State. Durban

DATE	DESCRIPTION
	was not directly affected by the war, as most of the battles which took place in Kwazulu-Natal occurred at towns such as Dundee, Ladysmith and Talana. The three attempted invasions of Natal by the Boer forces (at the beginning of 1900, in September 1901 and in March 1902) were all repulsed successfully by the British forces (Brookes & Webb, 1979).
1904	In this year, Mohandas Karamchand Ghandi, who had lived in Durban since 1893, established the settlement of Phoenix (www.wikipedia.org). His reconstructed house is located roughly 8 km north-west of the study area.
1910	The Nazareth Baptist Church was established by Isaiah Shembe at Inanda. Shembe established this church on a freehold farm known as ekuPhakameni which he had purchased a short while before (www.wikipedia.org). This Shembe church is located 11 km north-west of the present study area.
 *Isaiah Mloyiswa Mdliwamafa Shembe (c. 1870 – 2 May 1935) who established the Nazareth Baptist Church in 1910 (www.ulwazi.org).*	
1920	Umhlanga Rocks resort and residential village was established when local farmers began to build holiday cottages on the ocean front around the Umhlanga River and in 1920, Virginia Campbell and her husband built a hotel near the mouth of the Mhlanga River. In 1970, Umhlanga became an independent borough and two years later, incorporated La Lucia, a residential area to the south (Erasmus, 2014).
1921 - 1926	By 1921, various suburbs had sprung up around Durban and Village Management Boards were formed to provide some form of management. In

DATE	DESCRIPTION
	1926, the Natal Provincial Administration Board established Local Administration and Health Boards for certain areas (Henderson & Pay, 1939).
1931 - 1935	This was followed by the Durban Borough Extension and Loan Ordinance of 1931. The Municipal area was enlarged to some 67 square miles. In 1935, the status of Durban was raised to that of a city (Henderson & Pay, 1939).
1948-1950	The Ghetto Act, passed in 1948 and the Group Areas Act, passed in 1950, proclaimed certain areas for whites only. This meant that the non-White communities who found themselves in these areas would have to be moved to other areas designated as 'Indian', 'Coloured' or 'African'. The Group Areas Act displaced thousands of Indians and Africans from their homes and businesses. Indians were removed from areas such as Mayvile, Cato Manor, Clairwood, Magazine Barracks and the Bluff (www.sahistory. org.za).
1950s	As a result of the Group Areas Act, which was proclaimed in 1950, a number of residential areas were established for Black, Indian and Coloured people who were removed from other areas. These newly established townships were KwaMashu, Newlands East, Newlands West and Reservoir Hills. KwaMashu, for example, was one of the first of Durban's dormitory townships that emerged with the implementation of the Apartheid Group Areas Act during the 1950s. KwaMashu resulted from the mass resettlement of the slum population of Cato Manor during the period of 1958 to 1965 (www.sahistory.org). Before the establishment of the township, the area was a sugar cane plantation owned by Marshall Campbell (www.ulwazi.org). The name means "the place of Mashu", Mashu being the Zulu name for Sir Marshall Campbell (Erasmus, 2014). Newlands East, for example, was established as a township for Coloured people after the promulgation of the Group Areas Act (Khan, 2013). It would appear that Newlands West was also planned for Coloured people. Reservoir Hills is another of the areas that was zoned for Indian residence after the Group Areas Act was implemented in 1950 (Schensul, 2009). At the time, it was apparently advertised as, "an Indian area available for the more well to do Indians" (http://www.sahistory.org.za/indian-community).

Topographical maps obtained from the Directorate: Surveys and Mapping in Cape Town were used to compile a historic layering of the study area. Overlays were made on Google Earth.

First Edition Sheets 1:50 000 2931CA 1942 Verulam and 2930DD & 293 CC 1940 Durban

The proposed sewer infrastructure alternatives fall on the border of two sheets. This map indicates that the study area did not indicate any heritage features, except for a railway line located to the west of the study area. These two map sheets were drawn in the Trigonometrical Survey Office and printed in 1940 and 1942 by the Government Printer of the Union of South Africa.

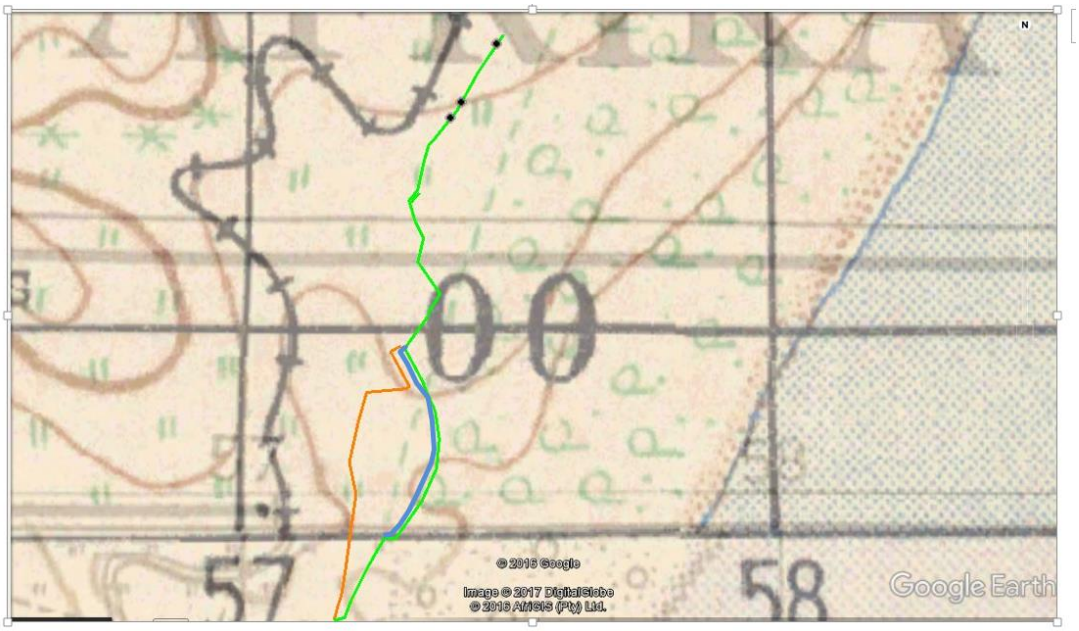


Figure 28: View of an enlarged section of the First Edition 1:50 000 2931CA 1942 Verulam and 2930DD & 293 CC 1940 Durban Sheets overlaid on Google Earth and showing the absence of heritage features in the immediate vicinity of the three sewer alternatives

Second Edition 1:50 000 2931CA 1969 Verulam and Fifth Edition 2930DD & 293 CC 19 Durban

The area covered by the three sewer alternatives falls on the border of two sheets. The 1969 Verulam map sheet was based on aerial photography carried out in 1959, was surveyed in 1969 and drawn in 1971 by the Trigonometrical Survey Office. The sheet was reprinted and published in 1979 by the Government Printer. The 1956 Durban map sheet was based on aerial photography carried out in 1953, was surveyed in 1956 and drawn in 1960 by the Trigonometrical Survey Office. The sheet was partly revised in 1972 and reprinted and published in 1975 by the Government Printer.

This map indicates that the area proposed for the three sewer route alternatives did not depict any heritage features, except for the main road between Durban and Verulam located to the east of the three sewer alternatives and an intersection with two secondary roads running to

the north. One possible curved recti-linear feature is indicated in the position of the sewer alternative 1 and 3, but it is not clear what that may have been.

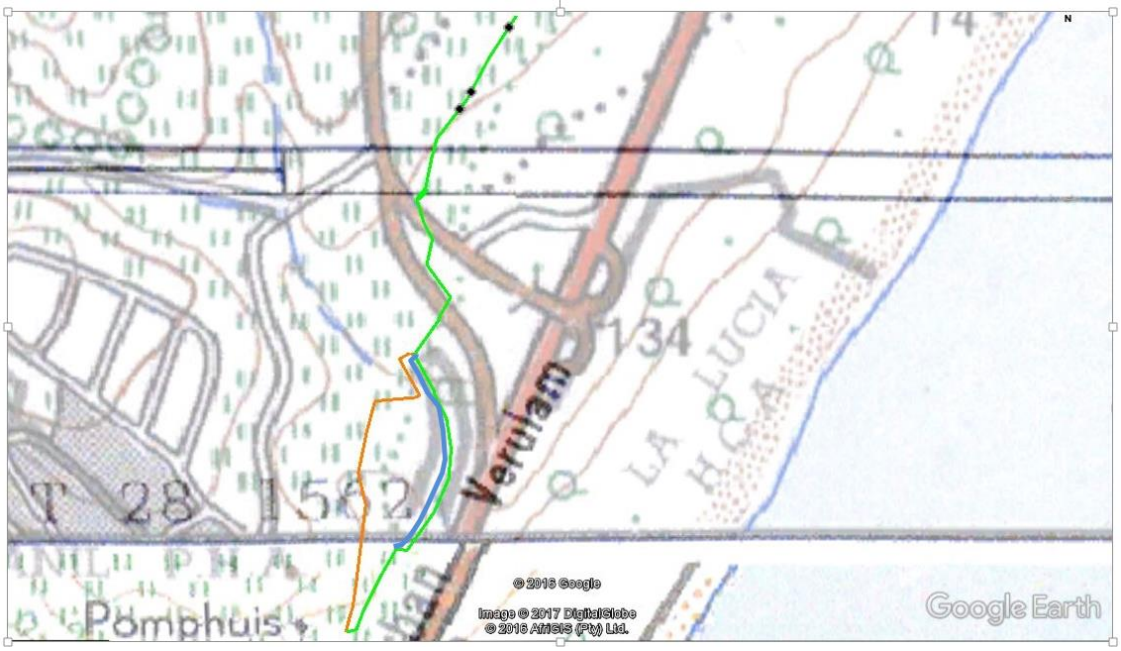


Figure 29: View of an enlarged section of the Second Edition 1:50 000 2931CA 1969 Verulam and Fifth Edition 2930DD & 293 CC 19 Durban Sheets overlaid on Google Earth and showing the absence of heritage features in the immediate vicinity of the three sewer alternatives

13.10 Watercourses

The upper portion of the study site is hydrologically isolated from the lower portion of the study site and is therefore being described and assessed separately. No wetland habitat or freshwater ecosystems that are hydrologically linked to the development footprint of the stormwater infrastructure were observed in the upper study site. However, the two wet attenuation ponds (Pond 1 and Pond 2) that have been constructed in the valley line upstream of the proposed stormwater infrastructure can be considered as watercourses according to the National Water Act (**Figure 30**). Both attenuation ponds are fed by surface water inputs as stormwater flows from the surrounding development areas are channelled into them via pipes, swales, culverts and surface runoff. The upper attenuation pond (Pond 1) currently attenuates flows from Umhlanga Rocks Drive and a portion of the hotel resort site while the lower wet attenuation pond (Pond 2) currently attenuates flows from Ridgeside Precinct 1, portions of Precincts 2 and 3 a portion of the proposed extension to the Umhlanga Ridge New Town Centre and the existing Umhlanga Ridge residential area (Goba 2008). Both attenuation ponds have been built on Berea Red sands and have been lined as Berea Red sands are extremely porous and water generally drains very quickly through them.

A swamp forest wetland habitat within an unchannelled valley-bottom was identified and delineated in the lower study site and was identified as being hydrologically linked to one of the proposed sewerage alignments and was therefore included in the wetland assessment.

This section provides a brief overview of the watercourses within the lower study area (**Figure 31**).

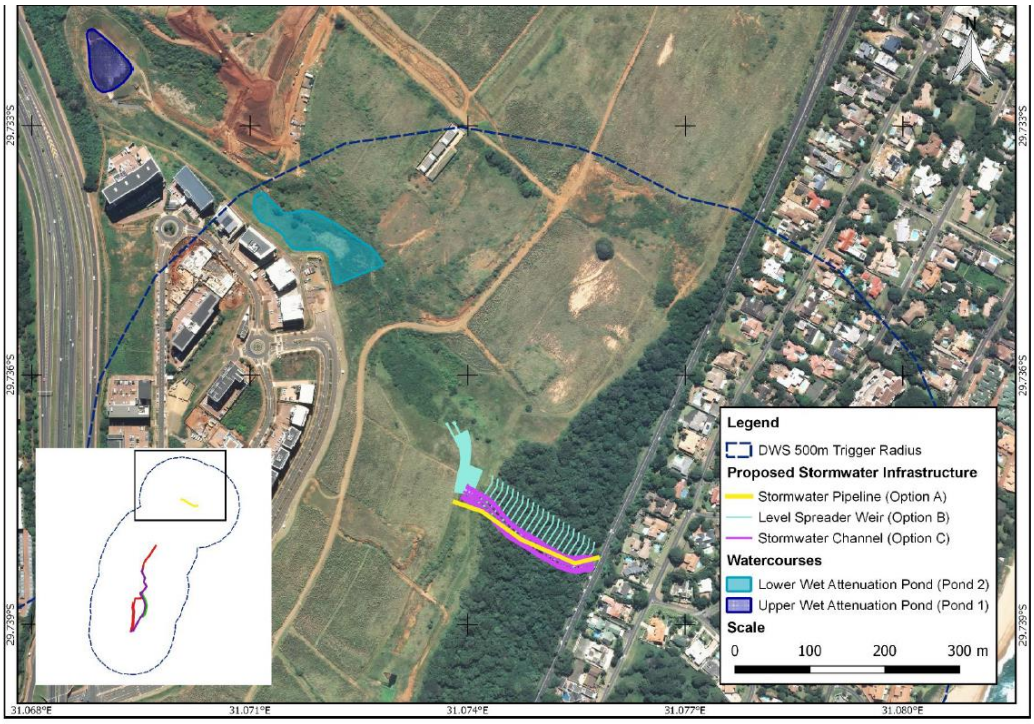


Figure 30: Overview of the watercourses within the upper study site that are associated with the proposed stormwater infrastructure alternatives

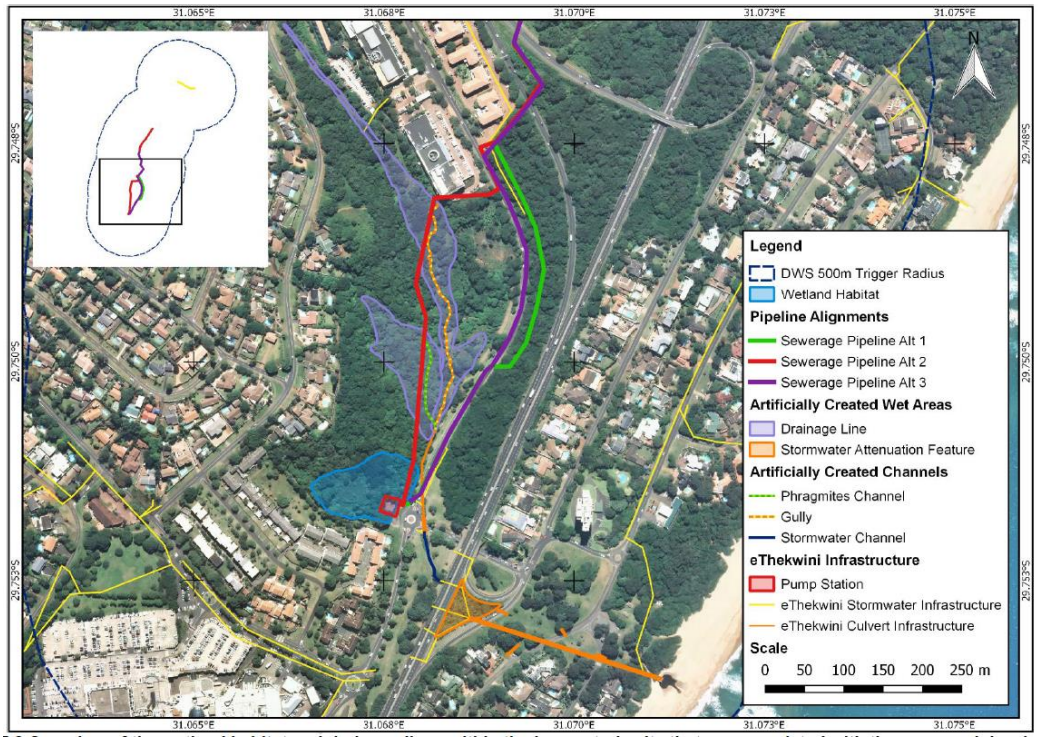


Figure 31: Overview of the wetland habitat and drainage lines within the lower study site that are associated with the proposed sewer infrastructure alternatives

13.10.1 Unchannelled valley-bottom

The unchannelled valley-bottom swamp forest is the only wetland ecosystem within the study site and covers an area of approximately 0.78ha (**Figure 31**). The system is considered to be fed both by sub-surface and surface water inputs, the latter being associated with stormwater inputs being discharged from the residential area located within the wetland's catchment. The wetland is an unchannelled valley-bottom wetland although there is a distinct but flat flow path where the majority of the surface flow is concentrated. The wetland is underlain by Berea Red sands which are considered to be extremely well-draining and poorly structured. The well-drained nature of the lithology is partly why the wetland receives large water contributions from sub-surface flows as well. A review of the soils in the wetland confirmed their poorly structured and weakly consolidated nature. The soils were recorded as very dark grey (10YR 3/1) in the top 0-20cm before giving way to a grey (10YR 6/1) soil matrix from 20cm down. Generally the top 20cm of the soil profile had a relatively high organic matter content whereas the soil below 20cm had a very low organic matter content and has been leached of almost all signs of iron.

The wetland is considered to be largely natural with a few modifications, predominantly due to the impacts associated with the urban setting of the catchment. The in-system impacts are largely associated with the sewage pump house that has been built within the swamp forest as well as the presence of some invasive alien plant species such as Ip*omoea indica, Solanum mauritianum, Schefflera actinophylla* and *Ricinus communis*. However, the typical swamp forest indicator species such as *Ficus trichopoda, Syzygium cordatum* and *Macaranga capensis* grow abundantly within the HGM unit. A number of other tree species were present in the swamp forest area such as *Ficus natalensis, Strelitzia nicolai* and *Celtis africana*. A few typical forest undergrowth species were also identified such as *Tarenna pavettoides, Nephrolepis biserrata* and *Commelina benghalensis*.

13.10.2 Artificially channelled drainage lines

Based on a review of the aerial imagery and infield verification, there are no additional wetlands within or beyond the study site boundary that are hydrologically linked to the construction of the sewerage pipelines. However, two distinct topographical features resembling drainage lines were delineated within the study site boundary, both hydrologically isolated from the wetland habitat, but both hydrologically linked to all three proposed sewerage pipeline alignments.

<u>Phragmites drainage line</u>

The first artificially channelled drainage line is located in the coastal forest habitat and is characterised by a series of small artificially created channels that link to a single main artificially created channel, all of which have largely been colonised by *Phragmites australis*. These channels were largely inaccessible due to the high density of *Phragmites australis*, *Ipomoea indica* and *Acacia schweinfurthii* in the areas surrounding the channels. As such, a portion of the drainage line was mapped using contour data at a desktop level. An existing sewerage network runs through the drainage line, connecting the office block to the north east

of the drainage line to the sewerage pump house located within the swamp forest (**Figure 31**). One of the sewerage manholes associated with this network is located at the head of the main channel and showed signs of recent surcharges as there was evidence of sewage around the manhole. It is likely that this channel network has been created either as a result of repeated leakages from the sewerage network or as a result of artificially concentrated stormwater flows entering the system from the drainage line catchment area. Thus, it is assumed that the channels have been artificially created and therefore the drainage line would not be considered as a watercourse by definition of the National Water Act (Act No.36 of 1998). The top 20cm of the soil profile within the main channel is characterised by organically enriched sand (7.5YR 4/3) which overlies a yellow apedal B layer (7.5YR 5/6) to approximately 60cm. The soil profile along the bottom end of the main channel is characterised by a leached layer at depths between 60 and 100cm. This leached layer is indicative of hydromorphic soil formation, and with continued water inputs may lead to the formation of wetland soils. Stagnant surface water was observed in portions of the main channel that showed signs of flocculation and iron reduction – which can be indicative of wetland habitat formation as well. *Phragmites australis* is an obligate wetland plant species and often indicates wetland habitat. The additional inputs of water and nutrients from the sewerage network could explain the concentration of *Phragmites australis* in an area where surface and elevated ground water is scarce.

A number of IAP species have colonised large sections of the drainage line. Some of these species included *Ipomoea indica, Solanum mauritianum, Ricinus communis, Chromolaena odorata* and *Tecoma stans*. Indigenous plant species identified in the drainage line include *Indigofera jucunda, Acacia schweinfurthii, Phragmites australis, Voacanga thouarsii* and *Commelina* sp. This drainage line is hydrologically isolated from the swamp forest wetland as the main channel flows into an adjacent drainage line with a prominent gully which discharges into a culvert that runs underneath Armstrong Road.

Gullied drainage line

This drainage line is characterised by a large gully that originates from a stormwater outlet on the south western side of the office block and runs down the remaining length of the drainage line where it meets a culvert at the toe of the drainage line which directs all surface flows underneath Armstrong Road (**Figure 31**). This 300m long gully has been artificially created by the stormwater flows generated by the office block and Armstrong Road and therefore the drainage line is not considered a watercourse by definition of the National Water Act (Act No.36 of 1998). The top 200m of the gully is still mobilising sediment and recent signs of erosion and deposition were observed during the site visit. However, the bottom 100m of the gully, before it converges with the culvert and the Phragmites channel, has been colonised by *Phragmites australis* and small stands of *Cyperus papyrus*, which indicates stabilisation of the gully. The soil profile of the bank and the channel bottom of the lower reaches of the gully is similar to that of the main Phragmites channel, with the top 20cm of the soil profile being organically enriched sand (7.5YR 4/3) which overlies a yellow apedal B layer (7.5YR 5/6).

Below 60cm, the soil profile gives way to a leached sand layer which is indicative of hydromorphic soil formation.

The gullied drainage line is characterised by similar vegetation to that of the Phragmites drainage line but included a wider variety of tree and shrub species such as *Celtis Africana, Voacanga thouarsii, Trema orientalis, Burchellia bubalina* and *Allophylus* sp.

13.10.3 Stormwater infrastructure

The culvert that collects water from the drainage lines runs beneath Armstrong Road and flow is discharged into a small channel directly across the road from the sewerage pump station. The channel also receives flows from the swamp forest wetland via a culvert. This channel links to the eThekwini Municipal stormwater network and is ultimately routed under the M4 highway (**Figure 31**). A number of soil samples were taken in the vicinity of the stormwater channel to check for hydrogeomorphic soil indicators. At a number of points close to the traffic circle and within the stormwater channel, gleyed soils mixed with yellow and red apedal soils were observed. However, the construction of the road and the resultant backfill have destroyed any wetland habitat that once may have occurred there. An attenuation facility, just before the M4 receives stormwater from a number of different stormwater inlets and discharges into a drop inlet culvert under the M4, with the stormwater network ultimately discharging onto the beach. A number of attenuation facilities were identified near the M4, Ridge Road and Forest Drive, but these all connected to the stormwater network via drop-inlet structures and no wetland indicators were observed in these areas.

14 SUMMARY OF SPECIALIST STUDIES

The following Specialist Studies undertaken as part of the BA Process, include:

1. Terrestrial Ecological Impact Assessment – This study was required to assess the potential impacts on the CBAs, threatened terrestrial ecosystem, DMOSS and natural forest area in the study area;
2. Phase 1 Heritage Impact Assessment – This study was required because of the size of the proposed sewer infrastructure and the potential occurrence of heritage resources and structures older than 60 years in the study area; and
3. Wetland Delineation Impact Assessment – This study was required to assess the potential impacts on the watercourses in the study area.

14.1 Terrestrial Ecological Impact Assessment

14.1.1 Details of the Specialist

Specialist	
Organisation:	Nemai Consulting

Specialist	
Name:	Mr. Avhafarei Phamphe
Qualifications:	MSc (Botany)
Affiliation (if applicable):	• Professional Natural Scientist-Ecological Science (Reg number: 400349/12) with South African council for Natural Scientific Professions (SACNASP) • Professional member of South African Institute of Ecologists and Environmental Scientists (SAIEES) • Professional member of South African Association of Botanists (SAAB)

14.1.2 Main Findings

14.1.2.1 Results and Discussion - Flora

During the field surveys, no threatened species or species of conservation importance were observed along the proposed infrastructure alternatives. In terms of the National Forests Act (Act No. 84 of 1998), certain tree species have been identified and declared as "*protected species*". DAFF has developed a list of protected tree species in the Act. One such species recorded on site was *Mimusops caffra*. This tree can be avoided by shifting the proposed sewer infrastructure alternatives 1 and 3 within the required servitude. However, a permit for either removing, destroying or disturbing this plant will be acquired from DAFF before any construction commences if avoidance is not possible. In order to reduce the impacts on the protected tree, the Applicant should purchase at least 10 medium to large sized *Mimusops caffra* on removal of the existing Coast Red Milkwood, and plant on the property as part of landscaping.

The proposed infrastructure alternatives traverse through the KwaZulu-Natal Dune Forest.

14.1.2.2 Results and Discussion - Fauna

The proposed sewer alternative 1 falls within the highly disturbed area dominated by alien plants and also along the main road, whereas the stormwater route is situated along the natural forest. Mammals recorded, namely House Rat, Grey /Common Duiker, Red forest Duiker, Vervet Monkey, Slender Mongoose, and Southern African Mole-rat were common and of no conservation importance in the area.

Conservation and planning tools were reviewed for relevancy in terms of the project area, and it was found that the study area did not contain or form part of any Important Bird and Biodiversity Area. An avifaunal study indicated that the forest areas provided suitable habitats for species recorded on site. No bird species of conservation concern were noted on site along the proposed infrastructure alternatives.

Large areas surrounding the proposed sewer infrastructure alternatives have resulted in increased habitat modification and transformation due to construction of roads and mixed used residential areas. The forest vegetation provides suitable habitat for several arboreal reptile species such as Boomslang (*Dispholidus typus typus*), Spotted Bush Snake (*Philothamnus variegatus*), Southern Tree Agama (*Acanthocercis atricolis*) and Common Dwarf Gecko (*Lygodactylus capensis*). There are many dead logs inside the forest areas that provide shelter

and food for some reptiles' species. During the field assessment, the following reptile species were noted on site, namely Distant's Ground Agama, Common Dwarf Gecko, Southern Tree Agama and Montane Speckled Skink. No reptile species of conservation concern were noted on site along the proposed infrastructure alternatives.

14.1.2.3 Terrestrial Sensitivity

Maps of the sensitivity and conservation value of the proposed infrastructure alternatives was developed (**Figure 32** and **33**). The maps indicate that the proposed stormwater infrastructure alternatives and sewer infrastructure alternative 2 are situated in highly terrestrial ecological sensitive areas.The maps also include the natural forest (KwaZulu-Natal Dune Forests : East Coast Dune Forest), the recommended 40m buffer zone for the forest area, the D'MOSS areas, the protected tree (*Mimusops caffra*), the KZN CBA: Irreplaceable Areas and the Northern Coastal Grasslands terrestrial threatened ecosystem.

Environmental Impact Assessment

An impact significance rating was assessed and impacts along the proposed sewer infrastructure alternatives 1 and 3 were found to be significantly reduced through the implementation of mitigation measures. However, impacts along the proposed stormwater infrastructure alternatives and also sewer infrastructure alternative 2 were rated between "high" prior to mitigation measures, and will remain permanent and "high" after mitigation as the forest is classified as *critically endangered*. Refer to Table 15 of the Terrestrial Ecological Assessment for a detailed impact assessment.

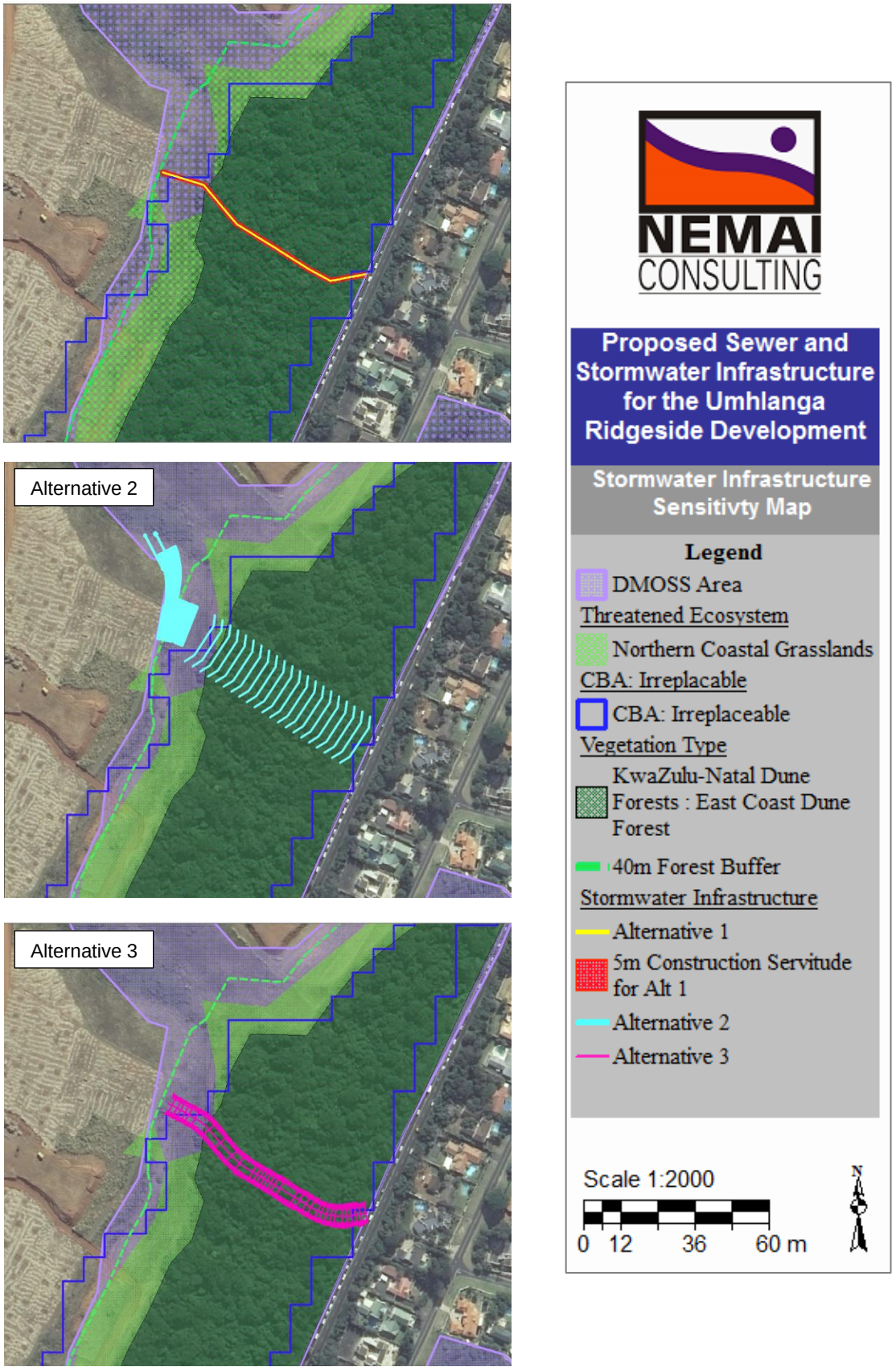


Figure 32: Terrestrial ecological sensitivity map of the proposed stormwater infrastructure alternatives

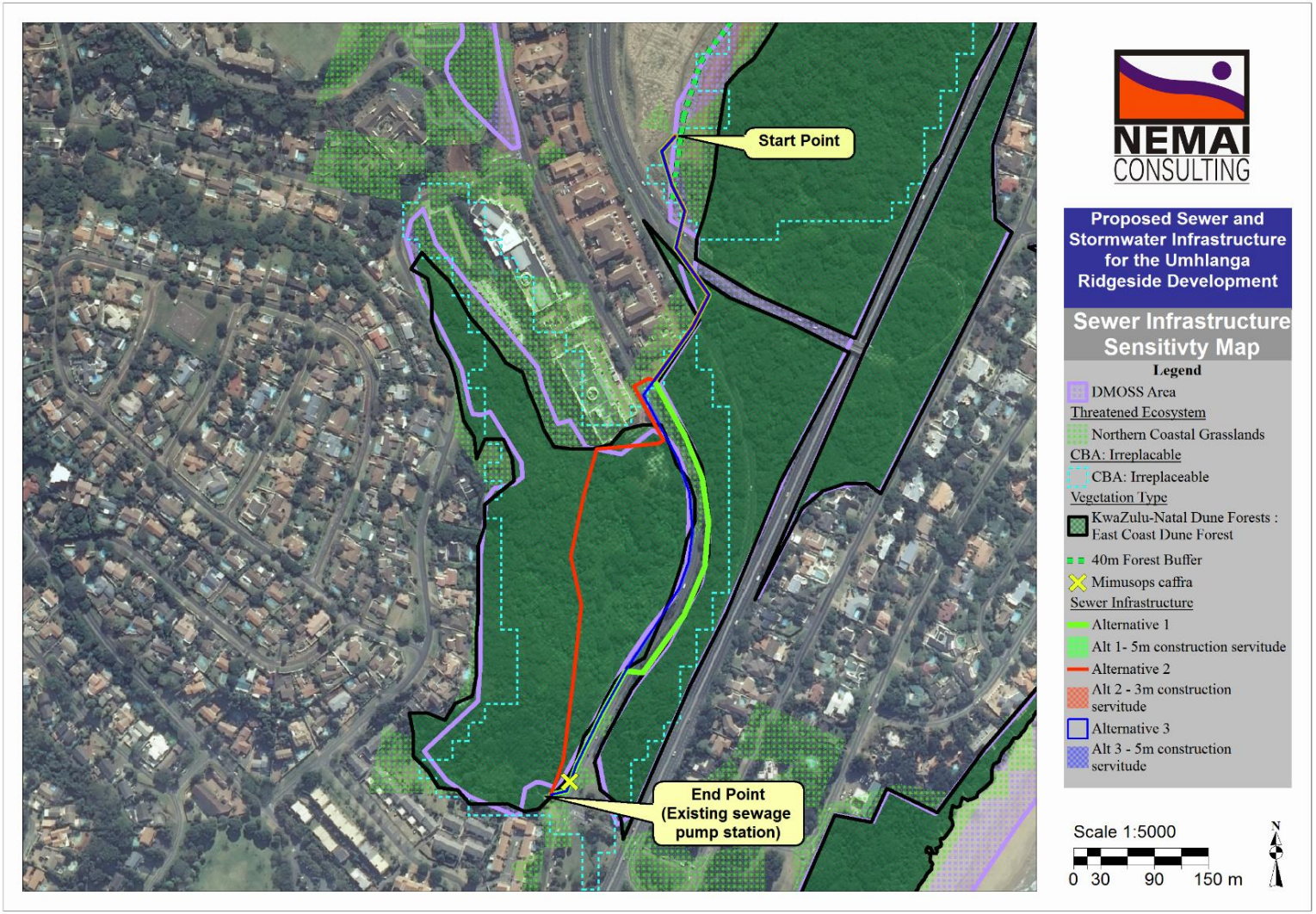


Figure 33: Terrestrial ecological sensitivity map of the proposed sewer infrastructure alternatives

14.1.3 Analysis of Alternatives

The proposed stormwater and sewer infrastructure alternatives were assessed from a terrestrial ecological point of view below:

Sewer Alternative routes	Preferred Option	Motivation
Sewer alternative 1	2	This route follows the main road (Armstrong Avenue) and will at least cause little damage to the forest areas, critically endangered areas and D'MOSS areas. Almost 0.18ha of the forest areas (including alien invasive plant species along the road reserve) will be cleared.
Sewer alternative 2	3	Even though this route follows the existing sewer pipeline, the existing servitude has not been maintained and thus the forest area has self-rehabilitated (grown back to its natural state). Thus areas along this route shouldn't be further impacted upon. This options entails more forested trees to be cleared/cut during construction activities. The servitude will need to be maintained constantly and that will lead to clearing of herbs, grass, trees and shrubs. Although only a 3m construction servitude is required, as opposed to alternatives 1 and 3 which require 5m, it is clear from Plate 1 below that more forest areas will be cleared/lost (approximately 0.16ha).
Sewer alternative 3	1	This route mostly follows the main road (Armstrong Avenue) and will at least cause little or no damage to the forest areas, critically endangered areas and D'MOSS areas. Less trees will be impacted upon along the western side of Armstrong Avenue as opposed to the eastern side. Pioneer tree species such as *Albizia adianthifolia, Trema orientalis* and *Croton sylvaticus* can be planted in order to speed up the rehabilitation process within the forest areas. Approximately only 0.09ha of the forest area will be cleared/lost.

Stormwater Alternative routes	Preferred Option	Motivation
Stormwater alternative 1	1	The corridor for excavation is much narrower (ie 2.5m on each side of the pegged route) than the other options and excavation will be done by hand. Approximately 0.09ha will be cleared/lost. This limits the impacts on the forest. This route will be rehabilitated after all the construction activities. Pioneer tree species such as *Albizia adianthifolia, Trema orientalis* and *Croton sylvaticus* can be planted in order to speed up the rehabilitation process within the forest areas.
Stormwater alternative 2	3	The footprint is much larger and also involves excavation for the installation of silt fences and sandbags. Approximately 0.77ha will be cleared/lost.
Stormwater alternative 3	2	The footprint for the stormwater channel is much larger than that of alternative 1. Approximately 0.32ha will be cleared/lost Any activities within the forest area are not allowed as they lead to habitat fragmentation and the less disturbances the better is for the forest. This option has risks with regards to siltation and erosion in the forest areas.

In conclusion, it is of the opinion of the Ecologist that Alternative 3 for the proposed sewer infrastructure and Alternative 1 for the stormwater infrastructure be selected from a terrestrial ecological point of view.

14.1.4 Conclusions and Recommendations

In terms of Land Use Guidance from Threat Status of Forests, no activities or development must be considered that will destroy forest and only low-impact eco-tourist facilities like boardwalks and bird-hides, but no buildings, infrastructure or bush camps in a Critically Endangered forest type. No site alternatives were possible for the proposed stormwater infrastructure and therefore in order to minimise the impacts that the proposed stormwater infrastructure will have on the forest, it is recommended that a manual pipeline installation be used instead of TLBs.

The disturbance and clearing of vegetation must be limited to areas of construction and the construction footprint must be limited to the absolute minimum required. All excavation must be done by hand in order to minimise the impacts on the forest as the severe impacts on the forest could lead to long-term damage to the environment. After the construction activities, there should be no permanent scar remaining and minimal or no forest fragmentation. All recommended mitigation measures must be included in the EMPr. The Forest Management and Restoration Report compiled by Newtown landscape Architects cc was considered when recommending mitigation measures for inclusion in the EMPr.

14.2 Heritage Impact Assessment (HIA)

14.2.1 Details of the Specialist

Specialist	
Organisation:	Nemai Consulting
Name:	Mr. Wouter Fourie
Qualifications:	BA (Hons) Archaeology and Geography
Affiliation (if applicable):	• Professional Archaeologist - Association of Southern African Professional Archaeologists (ASAPA) - Professional Member • Accredited Professional Heritage Specialist – Association of Professional Heritage Practitioners (APHP)

14.2.2 Main findings

No heritage sites were identified within the proposed sewer infrastructure study area. No mitigation measures and permits are therefore required and there are no “no go” areas identified.

14.2.3 Analysis of Alternatives

The Specialist had no preference to any of the proposed sewer infrastructure alternatives as no heritage resources were found.

14.2.4 Conclusion and Recommendations

No heritage sites were identified within the proposed sewer infrastructure study area. If any chance finds of heritage sites and/or objects be located or observed during construction, a heritage specialist must immediately be contacted and the General Management guidelines will apply:

General Management Guidelines

1. The NHRA (Act 25 of 1999) states that, any person who intends to undertake a development categorised as-

(a) the construction of a road, wall, transmission line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
(b) the construction of a bridge or similar structure exceeding 50m in length;
(c) any development or other activity which will change the character of a site-

(i) exceeding 5 000 m^2 in extent; or

(ii) involving three or more existing erven or subdivisions thereof; or

(iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or

(iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

(d) the re-zoning of a site exceeding 10 000 m2 in extent; or
(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

In the event that an area, previously not included in an archaeological or cultural resources survey is to be disturbed, the SAHRA needs to be contacted. An enquiry must be lodged with them into the necessity for an HIA.

2. In the event that a further heritage assessment is required it is advisable to utilise a qualified heritage practitioner, preferably registered with the Cultural Resources Management (CRM) Section of the ASAPA.

   This survey and evaluation must include:

(a) The identification and mapping of all heritage resources in the area affected;
(b) An assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6 (2) or prescribed under section 7 of the National Heritage Resources Act;
(c) An assessment of the impact of the development on such heritage resources;
(d) An evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;

(e) The results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;
(f) If heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
(g) Plans for mitigation of any adverse effects during and after the completion of the proposed development.

3. It is advisable that an information section on cultural resources be included in the SHEQ training given to contractors involved in surface earthmoving activities. These sections must include basic information on:

(a) Heritage;
(b) Graves;
(c) Archaeological finds; and
(d) Historical Structures.

This module must be tailor made to include all possible finds that could be expected in that area of construction.

Possible finds include:

a. Open air Stone Age scatters, disturbed during vegetation clearing. This will include stone tools.

b. Palaeontological deposits such as bone, and teeth in fluvial riverbank deposits.

4. In the event that a possible find is discovered during construction, all activities must be halted in the area of the discovery and a qualified archaeologist contacted.
5. The archaeologist needs to evaluate the finds on site and make recommendations towards possible mitigation measures.
6. If mitigation is necessary, an application for a rescue permit must be lodged with SAHRA.
7. After mitigation, an application must be lodged with SAHRA for a destruction permit. This application must be supported by the mitigation report generated during the rescue excavation. Only after the permit is issued may such a site be destroyed.
8. If during the initial survey sites of cultural significance are discovered, it will be necessary to develop a management plan for the preservation, documentation or destruction of such a site. Such a program must include an archaeological/palaeontological monitoring programme, timeframe and agreed upon schedule of actions between the company and the archaeologist.
9. In the event that human remains are uncovered, or previously unknown graves are discovered, a qualified archaeologist needs to be contacted and an evaluation of the finds made.
10. If the remains are to be exhumed and relocated, the relocation procedures as accepted by SAHRA need to be followed. This includes an extensive social consultation process.

Table 16: Roles and responsibilities of archaeological and heritage management when heritage resources are discovered during construction

ROLE	RESPONSIBILITY	IMPLEMENTATION
A responsible specialist needs to be allocated and should attend all relevant meetings, especially when changes in design are discussed, and liaise with SAHRA.	The client	Archaeologist and a competent archaeology support team
If chance finds and/or graves or burial grounds are identified during construction or operational phases, a specialist must be contacted in due course for evaluation.	The client	Archaeologist and a competent archaeology support team
Comply with defined national and local cultural heritage regulations on management plans for identified sites.	The client	Environmental Consultancy and the Archaeologist
Consult the managers, local communities and other key stakeholders on mitigation of archaeological sites, when discovered.	The client	Environmental Consultancy and the Archaeologist
Implement additional programs, as appropriate, to promote the safeguarding of our cultural heritage. (i.e. integrate the archaeological components into the employee induction course).	The client	Environmental Consultancy and the Archaeologist,
If required, conservation or relocation of burial grounds and/or graves according to the applicable regulations and legislation.	The client	Archaeologist, and/or competent authority for relocation services
Ensure that recommendations made in the Heritage Report are adhered to.	The client	The client
Provision of services and activities related to the management and monitoring of significant archaeological sites (when discovered). The client with the specialist needs to agree on the scope and activities to be performed	The client	Environmental Consultancy and the Archaeologist
When a specialist/archaeologist has been appointed for mitigation work on discovered heritage resources, comprehensive feedback reports should be submitted to relevant	Client and Archaeologist	Archaeologist

ROLE	RESPONSIBILITY	IMPLEMENTATION
authorities during each phase of development.		

All phases of the project

Archaeology:

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area.

It is possible that cultural material will be exposed during operations and may be recoverable, but this is the high-cost front of the operation, and so any delays should be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, but construction trenches do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project and these must be catered for. Temporary infrastructure is often changed or added to during the subsequent history of the project. In general, these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the construction phase, it is important to recognise any significant material being unearthed, and to make the correct judgment on which actions should be taken. In the event that possible heritage resources are identified a qualified archaeologist/palaeontologist must be contacted to evaluate the finds and make recommendations on the mitigation required.

In addition, feedback reports can be submitted by the archaeologist to the client and SAHRA to ensure effective monitoring. This archaeological monitoring and feedback strategy should be incorporated into the EMPr of the project. Should an archaeological/palaeontological site or cultural material be discovered during construction (or operation), such as graves or burial grounds, the project needs to be able to call on a qualified expert to make a decision on what is required and if it is necessary to carry out emergency recovery. SAHRA would need to be informed and may give advice on procedure. The developers therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered. The project thus needs to have an archaeologist/palaeontologist available to do such work. This provision can be made in an archaeological monitoring programme.

In the case where archaeological material is identified during construction the following measures must be taken:

- Upon the accidental discovery of archaeological material, a buffer of at least 20 meters should be implemented.

- If archaeological material is accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find. To remove the material permit must be applied for from SAHRA under Section 35 of the NHRA.

Graves:

In the case where a grave is identified during construction the following measures must be taken:

- Upon the accidental discovery of graves, a buffer of at least 50 meters should be implemented.
- If graves are accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find. To remove the remains a permit must be applied for from SAHRA (Section 36 of the NHRA) and other relevant authorities (National Health Act and its regulations). The local South African Police Services must immediately be notified of the find.
- Where it is recommended that the graves be relocated, a full grave relocation process that includes comprehensive social consultation must be followed.

The grave relocation process must include:

1. A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, that will be at least 60 days in length;
2. Site notices indicating the intent of the relocation;
3. Newspaper notices indicating the intent of the relocation;
4. A permit from the local authority;
5. A permit from the Provincial Department of Health;
6. A permit from the South African Heritage Resources Agency, if the graves are older than 60 years or unidentified and thus presumed older than 60 years;
7. An exhumation process that keeps the dignity of the remains intact;
8. The whole process must be done by a reputable company that is well versed in relocations.

14.3 Wetland Delineation Impact Assessment

14.3.1 Details of the Specialist

Specialist	
Organisation:	GroundTruth
Name:	Mr. Craig Cowden
Qualifications:	MSc. (Environmental Science)
Affiliation (if applicable):	• Professional Natural Scientist-Ecological Science (Reg number: 400197/05) with South African council for Natural Scientific Professions (SACNASP) • Founding Member - South African Wetland Society

Specialist	
	• Member - Society of Wetland Scientists (International) • Member - Society of Ecological Restoration (International)

14.3.2 Main Findings

14.3.2.1 Delineation

No wetlands were found on or near the study area for the proposed stormwater infrastructure alternatives; however, two wet attenuation ponds (Pond 1 and Pond 2) that have been constructed in the valley line upstream of the proposed stormwater infrastructure can be considered as watercourses according to the National Water Act (**Figure 30**).

A swamp forest wetland habitat within an unchannelled valley-bottom was identified in the study area for the proposed sewer infrastructure alternatives (**Figure 31**).

14.3.2.2 Wetland ecosystem functioning

As there was no wetland habitat delineated in the upper study site, no WET-EcoServices assessment was conducted for the upper study site. Therefore this section only refers to the functioning of the swamp forest wetland habitat located in the lower study site. The general features of the wetland habitat hydrologically linked to the proposed sewerage pipeline alignments in the lower study site were assessed in terms of the ecosystem functioning at a landscape level for the current scenario using a Level 2 Wet-EcoServices assessment. Generally, the values recorded for the ecosystem services for the current scenario were Moderately Low to High for the swamp forest wetland. Generally, the values recorded for the regulating and supporting services for the swamp forest were Intermediate, with the exception of erosion control and flood attenuation which scored as High and Moderately High, respectively. The ability of the HGM unit to attenuate floods and control erosion can be attributed to the fact that the swamp forest is characterised by dense stands of trees and relatively dense undergrowth – increasing the surface roughness of the HGM unit and its ability to decrease the effects of high flows.

14.3.2.3 Ecological Importance and Sensitivity

This section also only refers to the ecological importance and sensitivity of the swamp forest wetland habitat located in the lower study site. According to the DWA (2013) Manual for Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0), the wetland systems associated with the proposed development would be a B category for the swamp forest wetland. A B category indicates that the wetlands have a high ecological importance and sensitivity. The ecological importance and sensitivity (EIS) category for the swamp forest wetland is derived predominantly from both the ecological importance and sensitivity score, and the hydro-functional importance score 9. The high score for the ecological importance and sensitivity is related to the fact that the wetland is a swamp forest which is considered to be one of the most endangered wetland habitats in South Africa. The vegetation type is critically endangered and the protection status for the vegetation type is very poor which also contributes to the ecological importance and sensitivity score. The hydro-functional

importance score in this case is strongly linked to the provision of regulating and support ecosystem services – primarily flood attenuation and erosion control.

14.3.2.4 Wetland ecological condition/integrity assessment results

This section only makes reference to the swamp forest wetland habitat located in the lower study site as there were no wetland habitats delineated in the upper study site. No post-development assessment was conducted as the impacts associated with pipeline infrastructure are often too small to register in the WET-Health assessment. The ecological integrity or Present Ecological State (PES) of the HGM unit associated with the proposed Ridgeside sewerage pipeline alignment construction was assessed for the hydrology, geomorphology and vegetation components for the current scenario.

		Hydrology	Geomorphology	Vegetation	Overall Score
Wetland 1	Impact Score	3.0	0.7	1.1	1.8
	PES Category	C	A	B	B

The results of the assessments are outlined in the following sections.

Current scenario

Assessment of impacts on hydrology

The impact score recorded for the hydrological component of the wetland is 3.0, which indicates a Present Hydrological State (PHS) category of C. The change in ecosystem processes and loss of natural habitat is considered to be 'Moderate', with modifications to the wetland PHS being linked primarily to the following factors:

- The hardened surfaces in the catchment associated with the urban residential area are largely responsible for increased flows and altered floodpeaks to the swamp forest wetland. The extent of road surfaces, roofs and lawn greatly decreases the infiltration rate in the catchment meaning that there are larger surface flows reaching the HGM unit than would be the natural scenario.
- The presence of a number of invasive alien plant species within the HGM unit are responsible for increased water uptake in the HGM unit.

Assessments of impacts on geomorphology

The impact score recorded for the geomorphic component of the wetland is 0.7 which indicates a Present Geomorphology State (PGS) category of A for the swamp forest HGM unit. The PGS of the wetlands within the study area is considered to be intact. The limited impact on the geomorphic health of the wetland is primarily linked to:

- The increased floodpeaks and hydrological inputs from the catchment could potentially result in erosion of the HGM unit should a large flood come through the wetland.

Assessments of the impacts on vegetation

The impact score recorded for the vegetation component of the wetland is 1.1 translating into a Present Vegetation State (PVS) category of B for the wetland. The changes in ecosystem processes and loss of natural habitat is considered to be 'Minor', with modifications to the wetlands' PVS being linked primarily to the following factors:

- The presence of a local sewerage pump station located within the HGM unit. The associated concrete fence has also had an impact on the ability of indigenous, disturbance intolerant species to establish populations in its vicinity.
- The encroachment of pioneer and alien invasive vegetation into portions of the wetland habitat, largely linked to historical landuses and the fact that the swamp forest is secondary i.e. has only become established in the last 30 to 40 years.

Overall ecosystem integrity

For ease of interpretation the scores for hydrology, geomorphology and vegetation are able to be simplified into a composite impact score for the HGM units by weighting the scores obtained as outlined in Macfarlane et al. (2007). These scores were then used to derive hectare equivalents, which were used as the 'currency' for assessing the loss and/or gains in wetland integrity (Cowden and Kotze 2009). The overall hectare equivalents indicate that of the 0.78ha of wetland within the study area, 0.64ha can be considered as intact wetland habitat. This indicates that 82% of the wetland habitat is currently intact.

14.3.2.5 Identified Impacts

Watercourse risk assessment activities, impacts and risk ratings for stormwater infrastructure:

Phase	Activity	Aspect	Impact	Severity	Spatial Extent	Duration	Probability/ Likelihood	Significance	Risk Rating
Risk assessment for stormwater pipeline (Option A)									
Construction	Construction of stormwater pipeline	Operation of machinery	Pollution of watercourse and loss of biodiversity and habitat	1	1	1	8	24	L
		Minor earthworks	Siltation of watercourse	1	1	1	10	30	L
Operational	Operation of stormwater pipeline	Burst pipe	Loss of biodiversity and habitat and erosion of watercourse	1	1	1	12	39	L
Risk assessment for level spreader weirs (Option B)									
Construction	Construction of level spreader weir	Operation of machinery	Pollution of watercourse and loss of biodiversity and habitat	1	1	1	8	24	L
		Earthworks	Siltation of watercourse	1	1	1	8	24	L
Operational	Operation of level spreader weir	Scour below sandbags	Erosion below sandbags and siltation of watercourse	1	1	1	13	39	L
		Burst sandbags	Siltation of watercourse	1	1	1	12	36	L
		Tunnelling between sandbags	Siltation of watercourse	1	1	1	14	42	L

Risk assessment for stormwater channel (Option C)									
Construction	Construction of stormwater channel	Operation of machinery	Pollution of watercourse and loss of biodiversity and habitat	1	1	1	8	24	L
		Earthworks	Siltation of watercourse	1	1	1	8	24	L
Operational	Operation of level spreader weir	Overtopping of channel	Additional water inputs to surrounding environment, erosion of watercourse and resultant siltation of watercourse	1	1	1	12	36	L
		Blockage of channel	Additional water inputs to surrounding environment, erosion of watercourse and resultant siltation of watercourse	1	1	1	12	36	L

Watercourse risk assessment activities, impacts and risk ratings for sewerage pipeline alignments:

Phase	Activity	Aspect	Impact	Severity	Spatial Extent	Duration	Probability/ Likelihood	Significance	Risk Rating
Risk assessment for sewerage pipeline 1									
Construction	Construction of sewerage pipeline 1	Operation of machinery	Pollution of water resources and loss of biodiversity and habitat	1	1	1	8	24	L
		Minor earthworks	Siltation of wetland zone	1	1	1	10	30	L
Operational	Operation of sewerage pipeline 1	Burst pipe or manhole	Pollution of water resources and loss of biodiversity and habitat and erosion of watercourse	1,25	1	1	12	39	L
		Slow leak	Pollution of water resources and loss of biodiversity and habitat	1,25	1	1	12	39	L
Risk assessment for sewerage pipeline 2									
Construction	Construction of sewerage pipeline 2	Operation of machinery	Pollution of water resources and loss of biodiversity and habitat	2,5	1	2	11	60,5	M
		Minor earthworks	Siltation of wetland zone	2,25	1	2	12	63	M
Operational	Operation of sewerage pipeline 2	Burst pipe or manhole	Pollution of water resources and loss of biodiversity and habitat and erosion of watercourse	3,5	1	1	14	77	M
		Slow leak	Pollution of water resources and loss of biodiversity and habitat	1,75	1	2	15	71,25	M
Risk assessment for sewerage pipeline 3									
Construction	Construction of sewerage pipeline 3	Operation of machinery	Pollution of water resources and loss of biodiversity and habitat	1	1	1	8	24	L
		Minor earthworks	Siltation of wetland zone	1	1	1	10	30	L
Operational	Operation of sewerage pipeline 3	Burst pipe or manhole	Pollution of water resources and loss of biodiversity and habitat and erosion of watercourse	1,25	1	1	12	39	L
		Slow leak	Pollution of water resources and loss of biodiversity and habitat	1,25	1	1	12	39	L

14.3.3 Analysis of Alternatives

The study had no preference with regards to the stormwater infrastructure alternatives as no watercourses were affected. Therefore only the proposed sewer infrastructure alternative are discussed below. It is recommended that of the three pipeline alignments, 1 and 3 be given preference based on the results of the risk assessment. It is recommended that sewerage pipeline alignment 2 is not implemented. These recommendations are made based on the following:

- Pipeline alignments 1 and 3 tie into existing road infrastructure and would require minimal disturbance of natural wetland habitat to implement. Pipeline alignment 3 is possibly most preferential as sewerage alignment 1 requires the clearing of vegetation for the construction phase.
- The construction of Armstrong Road has already disturbed the landscape along its borders and therefore pipeline alignment 3 would run entirely through already disturbed soil profiles – making its development footprint smaller and easier to manage.
- Detection of sewage leaks during the operational phase will be significantly quicker and easier for pipeline alignments 1 and 3 as raw sewage would run straight onto Armstrong Road. Detection of sewage leaks along sewerage pipeline 2 would be significantly more difficult and could potentially go unnoticed for long periods of time as a large portion of the pipeline is located on private land and within dense forest habitat.
- The risks to the wetland habitat associated with sewerage alignments 1 and 3 are negligible in comparison to the risks that pipeline alignment 2 poses to the wetland habitat in both construction and operational phases.

This report has been based on the pipeline alignment provided to GroundTruth at the beginning of the study. Based on a review of the proposed pipeline alignment routes, pipeline alignment 3 is considered to be the most favourable as it will be aligned with existing road infrastructure and poses negligible threats to surrounding wetland habitat. Pipeline alignment 1 is less favourable than pipeline alignment 3 as it will require clearing of vegetation, but it too poses negligible risks to the swamp forest wetland habitat.

14.3.4 Conclusion and Recommendations

A 15m wetland buffer zone was recommended for both the construction and operation phase of the project (**Figure 34**).

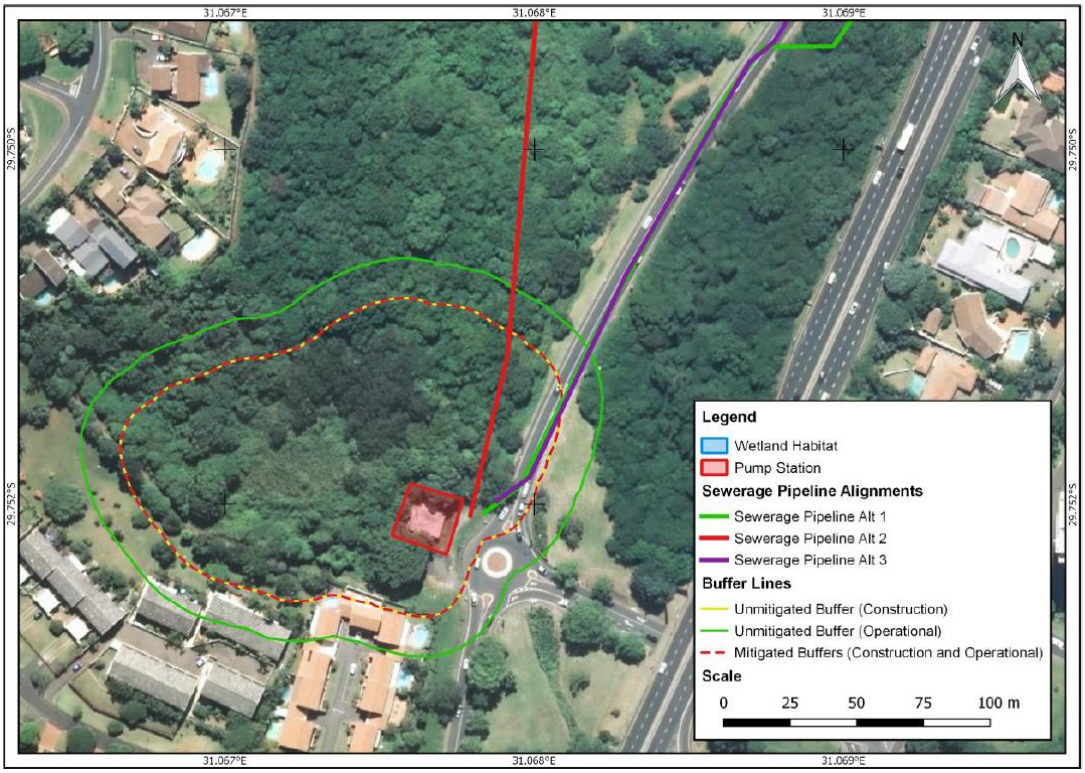


Figure 34: Overview of the unmitigated and mitigated construction and operational buffer zones

The wetland assessed within the study area was considered to be slightly modified with modifications associated predominantly with the urban nature of the catchment as well as the presence of a number of alien invasive plant species in the HGM unit.

None of the stormwater infrastructure designs located in the upper study site pose risks to any natural wetland habitat or freshwater ecosystems. All the proposed stormwater developments in the upper study site are located downstream of two watercourses (Pond 1 and Pond 2). These watercourses form part of the stormwater management plan compiled by Goba (2008) and flows from these watercourses will ultimately discharge into the proposed stormwater infrastructure (Options 1, 2 and 3). However, the risk posed by all three stormwater infrastructure designs to these watercourses is considered to be Low.

There are a number of potential risks associated with the construction and operation of the three sewerage alignments. The risks to wetland habitat associated with the construction and operation of each sewerage alignment was assessed separately as they each pose different threats to a wetland ecosystem nearby. Consideration of the principles and approach described in the DWS Risk Matrix, highlighted that two of the proposed sewerage pipeline alignments pose a Low Risk to wetland integrity whereas one of the sewerage pipeline alignments poses a Medium Risk.

15 IMPACT ASSESSMENT

15.1 Overview

This section focuses on the pertinent environmental impacts that could potentially be caused by the proposed stormwater and sewer pipeline during the pre-construction, construction and operational phases of the project.

Please note that an "impact" refers to the change to the environment resulting from an environmental aspect (or activity), whether desirable or undesirable. An impact may be the direct or indirect consequence of an activity.

The impacts to the environmental features are linked to the project activities, which in broad terms relate to the proposed development and its associated services and infrastructure.

Impacts were identified as follows:

- Impacts associated with listed activities contained in GN No. R. 985, for which authorisation has been applied for;
- Issues highlighted by environmental authorities;
- Comments received during public participation;
- An appraisal of the project description and the receiving environment; and
- Findings from specialist studies.

15.2 Environmental Activities

For the purposes of effective and efficient monitoring, the aspects of construction are outlined separately for pre-construction, construction and operational phases. In order to understand the impacts related to the project it is necessary to unpack the activities associated with the project life-cycle, as shown below:

Table 17: Activities associated with the Pre-construction Phase

PRE-CONSTRUCTION PHASE
Project Activities
1. Applicant to appoint ECO
2. Negotiations and agreements with affected landowners and stakeholders
3. Detailed engineering design
4. Detailed geotechnical design
5. Procurement of contractors

6. Site survey
7. Procurement of contractors
8. Development and approval of method statements
9. Development and approval of construction plans
10. Development of employment strategy
11. Construction site planning, access and layout
Environmental Activities
12. Diligent compliance monitoring of the EMPr, EA and other relevant environmental legislation
13. Obtain permits (such as for the protect tree) and Licenses (such as the WUL), if required
14. Demarcation of buffers around sensitive areas (such as the forest and wetland)
15. Ongoing consultation with landowners and the surrounding communities

Table 18: Activities associated with the Construction Phase

CONSTRUCTION PHASE
Project Activities
1. Site establishment
2. Fencing of the construction area
3. Site clearing
4. Stormwater control mechanisms
5. Delivery of construction material
6. Transportation of equipment, materials and personnel
7. Storage and handling of material
8. Excavation
9. Management of topsoil and spoil
10. Cut and cover activities
11. Stockpiling (sand, crushed stone, aggregate, etc.)
12. Waste and wastewater management
13. Traffic control measures

14. Construction of stormwater and sewer infrastructure
Environmental Activities
1. Diligent compliance monitoring of the EMPr, EA and other relevant environmental legislation
2. Conduct environmental awareness training
3. Control of invasive plant species
4. Reinstatement and rehabilitation of construction footprint
5. Landscaping
6. Ongoing consultation with landowners and the surrounding communities

Table 19: Activities associated with Operational Phase

OPERATIONAL PHASE
Project Activities
1. Maintenance of infrastructure
2. Routine maintenance inspections
3. Repair and maintenance works
4. Operation of the sewer and stormwater reticulation
Environmental Activities
5. Erosion monitoring programme
6. Stormwater management
7. Pollution control measures
8. Ongoing consultation with landowners and the surrounding communities
9. Management of sensitive areas or buffered areas

15.3 Environmental Aspects

An environmental aspect is part of a projects activities that is likely to interact with the environment and cause an impact. For example, while storing and handling hazardous materials on site (activity), a spillage could occur (aspect), which could result in pollution of

the adjacent wetland (impact). Potential environmental aspects have been identified in **Table 20** for the proposed project, which are linked to the project activities.

Table 20: Environmental aspects associated with the proposed project

ENVIRONMENTAL ASPECTS
Pre-construction Phase
1. Insufficient construction site planning and layout
2. Poor consultation with landowners, affected parties, stakeholders and authorities
3. Site-specific environmental issues not fully understood
4. Not obtaining relevant required Authorisations, Licenses, Permits, Way-Leaves, etc.
5. Inadequate environmental and compliance monitoring
6. Lack of barricading of sensitive environmental features
7. Poor waste management
8. Absence of ablution facilities
Construction Phase
1. Poor consultation with landowners, affected parties, stakeholders and authorities
2. Inadequate environmental and compliance monitoring
3. Lack of environmental awareness creation
4. Indiscriminate site clearing
5. Poor site establishment
6. Poor management of access and use of access roads
7. Poor traffic management
8. Disturbance of topsoil
9. Disruptions to existing services
10. Inadequate storage and handling of material
11. Inadequate storage and handling of hazardous material

12. Poor erosion control
13. Poor maintenance of equipment and plant
14. Poor management of labour force
15. Pollution from ablution facilities
16. Inadequate management of construction camp
17. Poor waste management practices – hazardous and general solid, liquid
18. Poor management of pollution generation potential
19. Poor management of water
20. Damage to significant fauna and flora
21. Environmental damage of sensitive areas (forest and wetland)
22. Disruption of archaeological and culturally significant features (if encountered)
23. Dust and emissions
24. Noise nuisance due to construction activities
25. Poor reinstatement, landscaping and rehabilitation
Operational Phase
1. Poor consultation with landowners, affected parties, stakeholders and authorities
2. Inadequate environmental and compliance monitoring
3. Inadequate management of access, routine maintenance and maintenance works
4. Poor stormwater management
5. Inadequate management of vegetation

15.4 Potential Significant Environmental Impacts

Environmental impacts are the change to the environment resulting from an environmental aspect, whether desirable or undesirable. Refer to **Tables 21** and **22** for the potential significant impacts associated with the preceding activities and environmental aspects for the pre-construction, construction and operational phase.

Table 21: Potential significant environmental impacts during Construction Phase

Feature	Impact
Geology	• Unsuitable geological conditions • Soil erosion (land clearance and construction activities) • Soil pollution (e.g. hydrocarbon and cement spillages) • Soil contamination through spillages and leakages • Poor stormwater management during construction
Terrestrial Ecology	• Impacts to sensitive terrestrial ecological features • Potential loss of significant flora and fauna species • Damage / clearance of habitat of conservation importance in construction domain • Proliferation of exotic vegetation
Air Quality	• Excessive dust levels • Greenhouse gas emissions
Noise	• Localised increase in the noise levels during construction
Aesthetic Quality	• Visual quality and sense of place to be adversely affected by construction activities
Socio – Economic	• Generation of employment opportunities for local community (positive) • Nuisance from noise and dust • Safety and security • Use of local road network
Transportation	• Construction-related traffic
Existing Infrastructure	• Crossing of existing infrastructure (including roads and services) • Relocation of structures
Heritage Resources	• Possible disturbance and destruction of heritage resources

Watercourses	• Surface water pollution due to spillages and poor construction practices
	• Encroachment of construction activities into riparian zones / wetlands
	• Impacts where the powerline crosses watercourses, such as:
	  ○ Loss of riparian and instream vegetation within construction domain
	  ○ Destabilisation of banks of watercourses
	• Sedimentation

Table 22: Potential Significant Environmental Impacts during Operation Phase

Feature	Impact
Geology	• Unsuitable geological conditions
Terrestrial Ecology	• Encroachment by exotic species through inadequate eradication programme • Loss of sensitive ecosystems (threatened ecosystem, CBA and forest area) which provide habitat for a number of species
Aesthetic Quality	• Inadequate reinstatement and rehabilitation of construction footprint
Socio – Economic	• Service provision for the Umhlanga Ridgeside Development
Watercourses	• Potential increase in the PES, EI and ES by pollution through possible spillages, erosion, and sedimentation

15.5 Impact Assessment Methodology

The impact assessment carried out for each environmental impact that may result from the proposed project, forms the basis for determining which management measures are required to prevent or minimise these impacts. The management measures are furthermore a means by which the mitigation measures, determined in the impact assessment are translated to action items required to prevent or keep those impacts that cannot be prevented within acceptable levels.

Mitigation should strive to abide by the following hierarchy (1) prevent; (2) reduce; (3) rehabilitate; and/or (4) compensate for the environmental impacts.

Figure 35: Mitigation Hierarchy

In order to establish best management practices and prescribe mitigation measures, the following project-related information needs to be adequately understood:

- **Activities** associated with the proposed project;
- **Environmental aspects** associated with the project activities;
- **Environmental impacts** resulting from the environmental aspects; and
- The nature of the surrounding **receiving environment**.

Information provided by specialists was used to calculate an overall impact score by multiplying the product of the nature, magnitude and the significance of the impact by the sum of the extent, duration and probability based on the following equation:

Overall Score = (NxMxS)x(E+D+P)

Where: N = Nature;
E = Extent
M = Magnitude
D = Duration
P = Probability
S = Significance

Table 23: Impact methodology table

Nature				
Negative		Neutral		Positive
-1		0		+1
Extent				
Local	Regional		National	International
1	2		3	4
Magnitude				
Low		Medium		High
1		2		3
Duration				
Short Term (0-5yrs)	Medium Term (5-11yrs)		Long Term	Permanent
1	2		3	4
Probability				
Rare/Remote	Unlikely	Moderate	Likely	Almost Certain
1	2	3	4	5
Significance				
No Impact/None	No Impact After Mitigation/Low		Residual Impact After Mitigation/Medium	Impact Cannot be Mitigated/High
0	1		2	3

The following definitions apply:

For the methodology of the impact assessment, the analysis is conducted on a quantitative basis with regard to the nature, extent, magnitude, duration, probability and significance of the impacts. The following definitions and scoring system apply:

Nature (/Status)

The project could have a positive, negative or neutral impact on the environment.

Extent

- Local – extend to the site and its immediate surroundings.
- Regional – impact on the region but within the province.
- National – impact on an interprovincial scale.
- International – impact outside of South Africa.

Magnitude

Degree to which impact may cause irreplaceable loss of resources.

- Low – natural and social functions and processes are not affected or minimally affected.
- Medium – affected environment is notably altered; natural and social functions and processes continue albeit in a modified way.

- High – natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.

Duration

- Short term – 0-5 years.
- Medium term – 5-11 years.
- Long term – impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention.
- Permanent – mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

Probability

- Almost certain – the event is expected to occur in most circumstances.
- Likely – the event will probably occur in most circumstances.
- Moderate – the event should occur at some time.
- Unlikely – the event could occur at some time.
- Rare/Remote – the event may occur only in exceptional circumstances.

Significance

Provides an overall impression of an impact's importance, and the degree to which it can be mitigated. The range for significance ratings is as follows-

0 – Impact will not affect the environment. No mitigation necessary.

1 – No impact after mitigation.

2 – Residual impact after mitigation.

3 – Impact cannot be mitigated.

For example, the worst possible impact score of -117 would be achieved based on the following ratings:

N = Nature = -1

M = Magnitude = 3

S = Significance = 3

E = Extent = 4

D = Duration = 4

P= Probability = 5

Worst impact score = (-1 x 3 x 3) x (4+4+5) = -117

On the other hand, if the nature of an impact is 0 (neutral or no change) or the significance is 0 (no impact), then the impact will be 0.

Impact Scores will therefore be ranked in the following way:

Table 24: Ranking of overall impact score

Impact Rating	Low/Acceptable impact	Medium	High	Very High
Score	0 to -30	-31 to -60	-61 to -90	-91 to -117

16 IMPACT MANAGEMENT

The impacts for each environmental feature identified are assessed for the pre-construction, construction, and operation phases for the proposed stormwater and sewer infrastructure for the Umhlanga Ridgeside Development.

16.1 Geology

16.1.1 Potential Impacts

The proposed development will require suitable geological foundation conditions, which will be confirmed through geotechnical investigations. The EMPr will include suitable stormwater management measures to prevent the occurrence of erosion.

Soil may be polluted by poor storage of construction material, spillages and inadequate housekeeping practices. Specific mitigation measures are contained in the EMPr, where the primary objective is the effective and safe management of materials on site, in order to minimise the impact of these materials on the biophysical environment. The same objective applies to the correct management and handling of hazardous substances (e.g. fuel).

16.1.2 Impact Assessment

Geology							
Project Life-cycle:	Construction and Operation						
Potential Impact:	Soil erosion						
Proposed Mitigation:	• Stabilisation of cleared areas to prevent and control erosion. The method chosen (e.g. watering, planting, retaining structures, commercial anti-erosion compounds) will be selected according to the site specific conditions. Drainage management should also be implemented to ensure the minimization of potential erosion. • Rehabilitate all areas disturbed during construction. • Monitoring to be conducted to detect erosion.						
	Nature	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Medium	Likely	2	-28
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

Geology	
Project Life-cycle:	Construction and Operation
Potential Impact:	Contamination of Soil

Proposed Mitigation:	• Wind and water erosion-control measures to be implemented to prevent loss of topsoil. • After excavation, all soils must be replaced in the same order as they were removed. • Remove, stockpile and preserve topsoil for re-use during rehabilitation. • Topsoil should be temporarily stockpiled, separately from (clay) subsoil and rocky material, when areas are cleared. If mixed with clay sub-soil the usefulness of the topsoil for rehabilitation of the site will be lost. • Stockpiled topsoil should not be compacted and should be replaced as the final soil layer. No vehicles are allowed access onto the stockpiles after they have been placed. • Stockpiled soil shall be protected by erosion-control berms Topsoil stripped from different sites must be stockpiled separately and clearly identified as such. Topsoil obtained from sites with different soil types must not be mixed. • Topsoil stripped from different sites must be stockpiled separately and clearly identified as such. Topsoil obtained from sites with different soil types must not be mixed. • Topsoil stockpiles must not be contaminated with oil, diesel, petrol, waste or any other foreign matter, which may inhibit the later growth of vegetation and microorganisms in the soil. • Soil should be exposed for the minimum time possible once cleared of invasive vegetation, that is the timing of clearing and grubbing should be coordinated as much as possible to avoid prolonged exposure of soils to wind and water erosion. Stockpiled topsoil must be either vegetated with indigenous grasses or covered with a suitable fabric to prevent erosion and invasion by weeds.						
	Nature	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Medium	Likely	2	-28
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

16.2 Terrestrial Ecology - Flora

16.2.1 Potential Impacts

Potential Impacts include:

- Destruction of indigenous flora (including a protected tree)
- Loss and displacement of animals on site
- Loss of Habitat and Habitat Fragmentation
- Loss of vegetation due to fuel and chemical spills
- Introduction of alien species
- Damage to plant life outside of the proposed infrastructure alternatives
- Loss of forest

16.2.2 Impact Assessment

The impact assessment below was extracted from the Terrestrial Ecological Assessment Study (**Appendix 7A**):

FLORA PRE – CONSTRUCTION PHASE	
Potential Impact	Mitigation
Destruction of a protected tree	• The placement of the proposed sewer infrastructure alternatives 1 and 3 can be aligned in order to avoid the protected tree (*Mimusops caffra)* on along this route. • In case where avoidance is not possible, a permit from DAFF is required in order to cut, disturb, destroy or remove the *Mimusops caffra* along the route. • In order to reduce the impacts on the protected tree within the critically endangered forest, the Applicant should purchase at least 10 medium to large sized *Mimusops caffra* on removal of the existing Coast red Milkwood, and replant them on the property as part of landscaping.

FLORA PRE – CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA PRE – CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Destruction of indigenous flora	• Indigenous plants naturally growing along proposed infrastructure alternatives, but that would be otherwise destroyed during clearing for development purposes should be incorporated into landscaped areas. • Vegetation clearing should be kept to a minimum, and this should only occur where it is absolutely necessary and the use of a brush-cutter is highly preferable to the use of earth-moving equipment. • Rehabilitate all disturbed areas as soon as the construction is completed within the proposed development areas. • Ensure that all personnel have the appropriate level of environmental awareness and competence to ensure continued environmental due diligence and on-going minimisation of environmental harm and this can be achieved through provision of appropriate awareness to all personnel. • All trees that have been identified to be removed are to be marked and verified with an Ecologist/ECO and carefully removed. • The location of the site office and Contractor's camp must be situated outside of the forest area. • The final development area should be surveyed for species suitable for search and rescue, which should be translocated prior to the commencement of construction activities					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA AND FAUNA PRE – CONSTRUCTION PHASE	
Potential Impact	Mitigation
Loss of Habitat and Habitat Fragmentation	• The most significant way to mitigate the loss of habitat is to limit the construction footprint within the forest areas, especially natural along the proposed stormwater route. • All development footprint areas should remain as small as possible and should not encroach onto surrounding areas. • No structures should be built outside the area demarcated for the development. • Although it is unavoidable that sections of the pipeline will need to traverse areas of potential sensitivity, the pipeline construction should be constructed in such cases so as to avoid further impact to these areas. • No personnel and construction equipment will be permitted beyond the pegged route

FLORA AND FAUNA PRE – CONSTRUCTION PHASE						
Potential Impact	Mitigation					
	• All trees/shrubs identified to be relocated/replanted, are to be carefully removed and replanted under the supervision of the ECO.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	2

FLORA CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Loss of vegetation due to fuel and chemical spills.	• Appropriate measures should be implemented in order to prevent potential soil pollution through fuel and oil leaks and spills and then compliance monitored by an appropriate person. • Make sure construction vehicles are maintained and serviced to prevent oil and fuel leaks. • Emergency on-site maintenance should be done over appropriate drip trays and all oil or fuel must be disposed of according to waste regulations. Drip-trays must be placed under vehicles and equipment when not in use. • Implement suitable erosion control measures					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Introduction of alien species.	• During construction, the construction area and immediate surroundings should be monitored regularly for emergent invasive vegetation • Promote awareness of all personnel. • The establishment of pioneer species should be considered with the natural cycle of rehabilitation of disturbed areas, which assists with erosion control, dust and establishment of more permanent species. This can be controlled during construction phase and thereafter more stringent measures should be implemented during the rehabilitation and post rehabilitation. • Larger exotic species that are not included in the Category 1b list of invasive species could also be allowed to remain for aesthetic purposes					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Destruction of alien vegetation.	• Due to the sensitivity of this forest, all alien seedlings and saplings must be removed as they become evident for the duration of project life • Manual/mechanical removal is preferred to chemical control.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Increased soil erosion	• Topsoil should be stored in such a way that does not compromise its plant-support capacity. • Topsoil from the construction activities should be stored for post-construction rehabilitation work and should not be disturbed more than is absolutely necessary. • Protect topsoil in order to avoid erosion loss on steep slopes. • Protect topsoil from contamination by aggregate, cement, concrete, fuels, litter, oils, domestic and wastes. • An ecologically-sound stormwater management plan must be implemented during construction and appropriate water diversion systems put in place.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Damage to plant life outside of the proposed infrastructure alternatives	• Construction activities should be restricted to the development footprint area and then the compliance in terms of footprint can be monitored by Environmental Control Officer (ECO). • Areas which could be deemed as no-go should be clearly marked. • Personnel, plant and equipment will have access strictly within the working area servitude. • All excavation will be done by hand and will be limited to 1.5m in depth. • During construction processes, the work area should not extend beyond 20m outside of the route reserve					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA AND FAUNA CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Loss of forest	• With regards to the stormwater pipeline through the forest, restricting the construction activities to the smallest practical/functional footprint would be the only possible mitigation in this case. • Manual pipelines installation (instead of using Tractor-Loader-Backhoes (TLBs)) would minimise the negative effects on the forest • All stockpiles, construction vehicles, equipment and machinery should be situated away from the forest areas. • Disturbance of vegetation must be limited only to areas of construction. • Prevent contamination of forests by any pollution. • Areas cleared of vegetation must be re-vegetated prior to contractor leaving the site. • Prior to the start of construction each day, an ECO should inspect and remove any animals that have become trapped in the open pipeline trench during the preceding night. • Proliferation of alien and invasive species is expected within the disturbed areas and they should be eradicated and controlled to prevent further spread into the forest areas. • No trapping or any other method of catching of any animal or bird may be performed on site • No access roads onto construction areas must be present and such areas must be fenced off during construction activities. • No storage of building materials or rubbles are allowed in the forest areas. • Avoid translocating stockpiles of topsoil from one place to forest areas in order to avoid translocating soil seed banks of alien species • Rehabilitate the servitude on completion by levelling with topsoil, replanting the same species composition of indigenous plants as was removed initially and caring for the plants until they become established. • Provide adequate ablution facilities to avoid using natural/sensitive areas as toilets. • Record the plant species removed from and/or damaged within the servitude. • Construction staff must be restricted to an allocated area and should not gain access to sensitive forest habitat. • Chemicals and equipment for the treatment of fuel spillages must be available on site at all times. • Confine all activities to within the pipeline servitude. • Limit construction activities to daytime. • Indigenous vegetation, which needs to be removed, should be replanted in an appropriate area or kept in a nursery for replanting at a later stage. • Where roots are encountered in excavations, these are to be treated as directed by the ECO/Ecologist. • Limit all construction activities to the minimum area required, and leave as much as possible forest area intact. • In forest developments, identify areas where there are significant gaps in the canopy.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	2

FLORA CONSTRUCTION/POST CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Loss of habitat due to construction activities	• All areas to be affected by the proposed project must be rehabilitated after construction and all waste generated by the construction activities will be stored in a temporary demarcated storage area, prior to disposal thereof at a licensed registered landfill site. • As much vegetation growth as possible should be promoted within the proposed development site in order to protect soils and to reduce the percentage of the surface area which is left as bare ground. In this regard special mention is made of the need to use indigenous vegetation species as the first choice during landscaping. In terms of the percentage of coverage required during rehab and also the grass mix to be used for rehab, the EMPr will be consulted for guidance. However, the plant material to be used for rehabilitation should be similar to what is found in the surrounding area.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

FLORA OPERATIONAL PHASE						
Potential Impact	Mitigation					
The proposed construction activities may affect biodiversity through the encroachment of exotic vegetation following soil disturbance.	Newly cleared soils will have to be re-vegetated and stabilised as soon as construction has been completed and there should be an on-going monitoring program to control and/or eradicate newly emerging invasives. The loss of the indigenous vegetation must be off-set and mitigated by the planting of indigenous woody vegetation.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

16.3 Terrestrial Ecology – Fauna

16.3.1 Potential Impacts

Vulnerable species could occur within the study area and the construction of the proposed development will have a negative impact on the habitats of such species. Fauna could be adversely affected through construction-related activities.

16.3.2 Impact Assessment

The impact assessment below was extracted from the Terrestrial Ecological Assessment Study (**Appendix 7A**):

FAUNA PRE – CONSTRUCTION PHASE	
Potential Impact	Mitigation
Loss and displacement of animals on site.	• An experienced person who knows the animals in the region well will identify any possible Red Data fauna on site and acquire the necessary permits to relocate fauna will be obtained if avoidance is not possible. • With regards to potential endemic and Red Data animal' species that could be found on site, all development footprint areas should remain as small as possible and should not encroach onto surrounding forest areas. • Training of construction workers to recognise threatened animal species will reduce the probability of fauna being harmed unnecessarily. • The contractor must ensure that no faunal species are disturbed, trapped, hunted or killed during the construction phase. • Vehicles must adhere to a speed limit, 30-40 km/h is recommended for light vehicles and a lower speed for heavy vehicles. • All construction and maintenance vehicles must stick to properly demarcated and prepared roads. Off-road driving should be strictly prohibited. • No fires should be allowed at the site • No dogs or other domestic pets should be allowed at the site. • If sensitive species are found during the clearance surveys, ECO will relocate individuals to suitable adjacent habitat at least 50m outside the disturbance corridor within 12 hours of capture.

Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

FLORA AND FAUNA PRE – CONSTRUCTION PHASE	
Potential Impact	Mitigation
Loss of Habitat and Habitat Fragmentation	• The most significant way to mitigate the loss of habitat is to limit the construction footprint within the forest areas, especially natural along the proposed stormwater route. • All development footprint areas should remain as small as possible and should not encroach onto surrounding areas. • No structures should be built outside the area demarcated for the development. • Although it is unavoidable that sections of the pipeline will need to traverse areas of potential sensitivity, the pipeline construction should be constructed in such cases so as to avoid further impact to these areas. • No personnel and construction equipment will be permitted beyond the pegged route • All trees/shrubs identified to be relocated/replanted, are to be carefully removed and replanted under the supervision of the ECO.

Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	2

FLORA AND FAUNA CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Loss of forest	• With regards to the stormwater pipeline through the forest, restricting the construction activities to the smallest practical/functional footprint would be the only possible mitigation in this case. • Manual pipelines installation (instead of using Tractor-Loader-Backhoes (TLBs)) would minimise the negative effects on the forest • All stockpiles, construction vehicles, equipment and machinery should be situated away from the forest areas. • Disturbance of vegetation must be limited only to areas of construction. • Prevent contamination of forests by any pollution. • Areas cleared of vegetation must be re-vegetated prior to contractor leaving the site. • Prior to the start of construction each day, an ECO should inspect and remove any animals that have become trapped in the open pipeline trench during the preceding night. • Proliferation of alien and invasive species is expected within the disturbed areas and they should be eradicated and controlled to prevent further spread into the forest areas. • No trapping or any other method of catching of any animal or bird may be performed on site • No access roads onto construction areas must be present and such areas must be fenced off during construction activities. • No storage of building materials or rubbles are allowed in the forest areas. • Avoid translocating stockpiles of topsoil from one place to forest areas in order to avoid translocating soil seed banks of alien species • Rehabilitate the servitude on completion by levelling with topsoil, replanting the same species composition of indigenous plants as was removed initially and caring for the plants until they become established. • Provide adequate ablution facilities to avoid using natural/sensitive areas as toilets. • Record the plant species removed from and/or damaged within the servitude. • Construction staff must be restricted to an allocated area and should not gain access to sensitive forest habitat. • Chemicals and equipment for the treatment of fuel spillages must be available on site at all times. • Confine all activities to within the pipeline servitude. • Limit construction activities to daytime. • Indigenous vegetation, which needs to be removed, should be replanted in an appropriate area or kept in a nursery for replanting at a later stage. • Where roots are encountered in excavations, these are to be treated as directed by the ECO/Ecologist. • Limit all construction activities to the minimum area required, and leave as much as possible forest area intact. • In forest developments, identify areas where there are significant gaps in the canopy.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	2

FAUNA CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Disturbance to animals	• To keep from attracting wildlife at night into the project site, all food-related trash such as cans, bottles, and food scraps should be disposed of in closed containers and regularly removed from the construction areas. • To reduce the chances of wildlife species being accidentally hit by construction vehicles, all construction vehicles should observe a 30-40 km/h speed limit through the proposed infrastructure alternatives. • Animals residing within the designated area shall not be unnecessarily disturbed. • During construction, refresher training can be conducted to construction workers with regards to littering and poaching. • The Contractor and his/her employees shall not bring any domestic animals onto site. • Toolbox talks should be provided to contractors regarding disturbance to animals. Particular emphasis should be placed on talks regarding snakes.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FAUNA OPERATIONAL PHASE						
Potential Impact	Mitigation					
Disturbance of faunal species	• The disturbance of fauna should be minimized. • Animals residing within the designated area shall not be unnecessarily disturbed.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

16.4 Air Quality

16.4.1 Potential Impacts

Potential impacts during the construction phase include:

- Dust will be generated during the construction period from various sources, including stockpiles, use of access roads, transportation of spoil material and general construction activities on site; and
- Exhaust emissions from vehicles and equipment.

Mitigation measures are included in the EMPr to ensure that the air quality impacts during the construction phase are suitably monitored (dust fallout and particulate matter) and managed and that regulated thresholds are not exceeded.

16.4.2 Impact Assessment

Air Quality							
Project Life-cycle:	Construction						
Potential Impact:	Excessive dust levels as a result of construction activities						
Proposed Mitigation:	• Appropriate dust suppression measures or temporary stabilising mechanisms to be used when dust generation is unavoidable (e.g. dampening with water, chemical soil binders, straw, brush packs, chipping), particularly during prolonged periods of dry weather. Dust suppression to be undertaken for all bare areas, including construction area and access roads. Note that all dust suppression requirements should be based on the results from the dust monitoring and the proximity of sensitive receptors. • Speed limits to be strictly adhered to.						
	Nature	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Low	Short	Likely	1	-6
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

16.5 Noise

16.5.1 Potential Impacts

During construction, localised increases in noise and vibration will be caused by construction activities. Noise that emanates from construction activities will be addressed through targeted best practices for noise monitoring and management in the EMPr. The associated regulated standards need to be adhered to. Project personnel working on the site will experience the greatest potential exposure to the highest levels of noise and vibration. Workplace noise and vibration issues will be managed as part of the Occupational Health and Safety Management System to be employed on site, which will include specific measures aimed at preventing hearing loss and other deleterious health impacts.

16.5.2 Impact Assessment

Noise							
Project Life-cycle:	Construction						
Potential Impact:	Excessive noise levels as a result of construction and operation activities						
Proposed Mitigation:	• The provisions of SABS 1200A will apply to all areas within audible distance of residents. • Working hours to be agreed upon with Project Manager, so as to minimise disturbance to landowners/occupiers and community members. • Construction activities generating output levels of 85 dB or more will be confined to normal working hours. • Noise preventative measures (e.g. screening, muffling, timing, pre-notification of affected parties) to be employed.						
	Nature	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Short	Likely	2	-24
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

16.6 Aesthetic Quality

16.6.1 Potential Impacts

Potential visual impacts during the construction phase of the powerline will be caused by poor placement of the construction camp and equipment, as well as poor management of rubble, refuse and construction material on site. Additionally, destruction of the surrounding natural environment would decrease the aesthetic appeal of the area. Thus, the visual impacts should be minimised.

16.6.2 Impact Assessment

Aesthetic Quality							
Project Life-cycle:	Construction						
Potential Impact:	• Reduction in visual quality due to construction activities						
Proposed Mitigation:	• On-going housekeeping to maintain a tidy construction area. • Construction camp to be positioned to minimize its visual impacts. • Damage to the natural environment should be minimised. • No construction rubble, construction material, refuse, litter or any other material not found naturally in the surroundings should be allowed at any time to be lying around on the construction site. • Particular aspects of concern to landowners and local residents should be addressed during construction.						
	Nature	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Short	Likely	2	-24
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

16.7 Socio-Economic Environment

16.7.1 Potential Impacts

A positive impact could be the creation of short-term work opportunities for local residents during construction, as well as long-term work during the operation of the pump station and maintenance of the pipeline. There are also negative impacts associated with the construction of the pipeline such as damages to the private and adjacent properties, and poor consultation with landowners and surrounding communities.

16.7.2 Impact Assessment

Socio-Economic Environment	
Project Lifecycle:	Construction and Operational Phase
Potential Impact:	Direct Employment
Proposed Mitigation:	• Where feasible introduce a programme to transfer skills particularly during the construction phase of the project. • Employment opportunities to be created for women. • A CLO should be appointed by the Contractor to effectively manage the employment process. • The selection process should be transparent and must include both men and women. • The project proponent should designated a person to ensure that employment is handled correctly, transparently and is not disruptive to the project. All evidence of the labour process must be stored by the project proponent.

	Nature +/-	Extent	Magnitude	Duration	Probability	Significance	Score
Without Mitigation	+	Local	Low	Short	Almost certain	2	+14
With Mitigation	+	Local	Medium	Short	Almost certain	3	+49
Project Lifecycle:	Construction Phase						
Potential Impact:	Damage to private and adjacent properties						
Proposed Mitigation:	• Register to be kept of recorded damages. • Damages caused by decommissioning activities to be repaired by Contractor. • Contractor to appoint a Community Liaison Officer (CLO), or to assign such responsibilities to a competent staff member who will have adequate time to fulfil relevant functions.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Short	Moderate	2	-20
With Mitigation	-	Local	Low	Short	Unlikely	1	-4
Project Lifecycle:	Construction Phase						
Potential Impact:	Poor communication with adjacent landowners and affected parties						
Proposed Mitigation:	• A CLO must be appointed on the project to manager the stakeholder engagement process during the construction phase. • Establish lines of communications with affected parties, adjacent landowners, and community members, particularly the adjacent school. • Establish processes and procedures to effectively verify and address complaints and claims received. • Provide the relevant contact details to affected parties, adjacent landowners, and community members for queries / raising of issues or complaints.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	High	Medium	Almost Certain	3	-72
With Mitigation	+	Local	High	Medium	Almost Certain	2	+48

16.8 Traffic

16.8.1 Potential Impacts

During the construction period, there will be an increase in traffic on the local road networks due to the delivery of plant and material, transportation of staff and normal construction-related traffic.

As part of the construction phase, measures will be implemented for the selective upgrade of the roads (if necessary) and to render these roads safe for other users (amongst others). After the construction phase, the local roads will only need to be used for operation and maintenance purposes.

All the appropriate traffic safety measures and control must be implemented to minimise any potential impacts. Any disruptions to the transportation network must be mitigated, and will be implemented in the EMPr.

16.8.2 Impact Assessment

Transportation	
Project Life-cycle:	Construction
Potential Impact:	• Inadequate road conditions • Disruptions to existing road users

Transportation							
Proposed Mitigation:	• Site layout must clearly indicate parking areas for the construction vehicles. • Construction vehicles should not be parked on public road access. • Speed limit of 40km/h on roads within the project area to be adhered to. • Access roads to be maintained in a suitable condition. • Suitable erosion protective measures to be implemented for access roads during the construction phase. • Traffic safety measures (e.g. traffic warning signs, flagmen) to be implemented. • Clearly demarcate all access roads. Clearly mark pedestrian-safe access routes.						
	Nature	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Low	Short	Likely	1	-6
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

16.9 Heritage Resources

16.9.1 Potential Impacts

Heritage resources such as archaeological and cultural-historical sites or artefacts may be found in or near the study area that could be destroyed during construction. Such heritage resources will need to be identified (if any) and protected (if required).

16.9.2 Impact Assessment

The impact assessment below was extracted from the HIA (**Appendix 7B**):

POTENTIAL IMPACTS (in order of impact as described in Impact Matrix)	ASPECT (refer to Impact Matrix)	Nature	Type	Extent	Duration	Severity	Reversibility	Irreplaceable Loss	Probability	MITIGATION POTENTIAL	IMPACT SIGNIFICANCE		MITIGATION MEASURES
											Without Mitigation	With Mitigation	
CONSTRUCTION PHASE													
Impacts on archaeological sites – chance finds	Heritage Resources	**Negative**	Direct	Site	Permanent	**Low**	Irreversible	Resource cannot be replaced	Unlikely	High	Low	Low	Refer to Section 8
Impact on burial grounds – chance finds	Heritage Resource	**Negative**	Direct	Site	Permanent	**High negative**	Irreversible	Resource cannot be replaced	Unlikely	Moderate or Partially Mitigatable	**High**	Low	Refer to Section 8

16.10 Watercourses

16.10.1 Potential Impacts

During the construction phase:

- Introduction of foreign materials (oil, fuel etc.);
- Destruction / degradation of adjacent / downstream natural habitat;
- Soil disturbance and compaction;
- Loss of ecosystem services associated with wetland habitat (if wetland habitat is located nearby);
- Trench erosion and the diversion of subsurface flow as a result of preferential flow paths having been created;
- In-system impoundments and the creation of sub-surface drainage as a result of poorly constructed pipeline trenches; and
- Removal of vegetation, increasing the opportunity for the encroachment of alien invasive vegetation.

During the operational phase:

- Introduction of additional water/material:
    - Burst pipelines could result in additional water inputs
    - Burst sandbags from riffle weirs could introduce additional sediment
- Erosion as a result of failed infrastructure:
    - Burst pipelines can cause erosion as a result of additional water inputs

16.10.2 Impact Assessment

The impact assessment below was extracted from the Wetland Study (**Appendix 7C**):

Stormwater Infrastructure:

Alternative 1

The risk to the upstream watercourses associated with the construction of the stormwater pipeline are considered to be Low. The stormwater pipeline is located downstream of the two wet attenuation ponds and the risks associated with a pipeline of this nature are generally limited to the construction footprint of the pipeline. All hydrological risks associated with the pipeline such as pipe bursts/leaks will only affect areas that are downstream of the pipeline. Thus, the risk posed to the watercourses by the construction of the stormwater pipeline are considered to be negligible.

Alternative 2

The construction and operation of the level spreader weir and control riffle weirs pose a Low Risk to the upstream watercourses. As with the stormwater pipeline, the risks associated with these weirs are predominantly conveyed via hydrological means, therefore the risk posed to the upstream watercourses is deemed to be negligible. However, it should be noted that the

risks associated with the sandbag riffle weir structures to downstream areas are more significant than the risks associated with hard structures such as pipelines or channels. The risk of tunnelling between or below sandbags is of particular concern as the soils and lithology upon which the sandbags would be built is extremely porous and lends itself to subsurface flows that may compromise the structural integrity of the erosion control measures. Tunnelling occurs when subsurface flows are directed between or underneath sandbags, severely weakening the strength of the structure over time. The tunnelling beneath or between sandbags could result in the failure of these structures during a storm event and it is likely that flooding and sedimentation of downstream areas would occur in this scenario. Sandbags also have a limited lifespan (despite them being UV resistant) and would need to be maintained and replaced on a much more frequent basis than a hard structure made of concrete or rock. Depending on the dimensions of the riffle weirs, there is also a risk associated with scour below the sandbag structures. If riffle weirs are built too high, the hydraulic energy that will be created during high flows when water flows over these structures could easily result in scour and erosion below the structures. This effect could be mitigated by placing rock packs below each riffle weir, but the risk associated with tunnelling would still prevail. So despite the level spreader weir and control riffle weirs posing a Low Risk to watercourses, there are other risks to downstream natural areas and infrastructure and these risks should be considered when selecting stormwater control measures in this particular area of forest.

Alternative 3

There is a Low Risk to upstream watercourses associated with the construction and operation of the stormwater channel. As with Alternative 1 and 2, the risks associated with the construction and operation of the stormwater channel are borne by hydrological means. Therefore, seeing as the stormwater channel alignment is downstream of the watercourses, it is deemed to pose a very low risk to these water resources.

<u>Sewer Infrastructure:</u>

Alternative 1 and 3

The risks associated with sewerage pipeline alignments 1 and 3 are considered to be Low. Pipeline alignments 1 and 3 are grouped together here as they will have a very similar development footprint and pose a similar risk to the nearby swamp forest wetland. The risks posed to the swamp forest habitat (which is of primary concern with regards to these three sewerage pipeline alignments) is negligible because the majority of the risks associated with the construction and operation of the pipelines are hydrologically derived. These two sewerage pipeline alignments are located outside of the swamp forest HGM unit and are also hydrologically isolated from the wetland area. Any sewage leaks that may originate from these two alignments during the operational phase would flow across Armstrong road to be picked up by the gully located to the west of these alignments and would be transported out of the D'MOSS area via the culvert running underneath Armstrong Road to be discharged into the stormwater management channel. Thus, the majority of the potential hydrologically derived impacts on the swamp forest posed by these two sewerage pipelines are negated by the gully

and the culvert. The only risk that these two alignments pose to the swamp forest is if there is a pipeline leak located within the last 20m of either alignment where the pipelines converge with the sewage pump station. However, these impacts would be negligible as they would only affect a very small portion of the toe of the swamp forest. It is important to note that should one of these two pipeline alignments burst, the leak would flow across Armstrong Road and would be very easily detected.

Alternative 2

The risks associated with the sewerage pipeline alignment 2 is considered to be Medium. The bottom end of sewerage pipeline alignment 2 runs directly through a portion of the swamp forest HGM unit, thus both construction and operational phases pose greater risks to the wetland habitat. During the construction phase, a number of trees will have to be removed to provide access to the necessary machinery for pipeline construction. The operation of heavy machinery will also result in the compaction of the land surface and the excavation of fill to bury the pipeline will pose a sedimentation risk to the wetland habitat in the event of heavy rain. During the operational phase, risks associated with surcharging manholes and leaking pipes are of greatest concern as this could damage the physio-chemical and biotic functioning of the wetland habitat. A large leakage from a sewerage manhole could release quantities of water that could result in erosion within the wetland habitat. The forested nature of this pipeline alignment makes detection of potential sewage leaks challenging and would have to be monitored regularly. However, sewage leaks originating from pipeline alignments 1 and 3 would be detectable immediately and could be dealt with accordingly.

16.11 Cumulative Impacts

According to GN No. R. 982 (04 December 2014, as amended), a ***"cumulative impact"***, in relation to an activity, means the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

Cumulative impacts can be identified by combining the potential environmental implications of the proposed project with the impacts of projects and activities that have occurred in the past, are currently occurring, or are proposed in the future within the project area. The following cumulative impacts are anticipated:

- Damage to ecologically sensitive areas;
- Encroachment of alien vegetation; and
- Damage to wetland habitat.

Cumulative Impacts	
Potential Impact:	Damage to ecologically sensitive areas. Over time, there could be further loss of threatened ecosystems, CBA Optimal areas and the forest with the opportunity of further development encroachment. A cumulative impact could be that more open spaces consisting of these sensitive ecological areas are lost in future once development further encroaches this area.

Proposed Mitigation:	• Appropriate measures should be implemented in order to prevent potential soil pollution through fuel and oil leaks and spills and then compliance monitored by an appropriate person. • Make sure construction vehicles are maintained and serviced to prevent oil and fuel leaks. • Emergency on-site maintenance should be done over appropriate drip trays and all oil or fuel must be disposed of according to waste regulations. Drip-trays must be placed under vehicles and equipment when not in use. • Implement suitable erosion control measures. • All conditions of the EMPr must be adhered to.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Long Term	Likely	2	-32
With Mitigation	-	Local	Low	Long Term	Unlikely	1	-6
Potential Impact:	Encroachment of alien vegetation						
Proposed Mitigation:	• Rehabilitation measures must be implemented once construction activities are complete to ensure that alien vegetation will be controlled during the construction and operational phases. • All conditions of the EMPr must be adhered to.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Short	Moderate	2	-20
With Mitigation	-	Local	Low	Short	Unlikely	1	-4
Potential Impact:	Damage to wetland habitat						
Proposed Mitigation:	• Keep all demarcated sensitive zones outside of the construction area off limits during the construction and rehabilitation phases of the development. • Monitor all systems for erosion and incision. • Re-vegetate all disturbed areas with indigenous wetland species. • All conditions of the EMPr must be adhered to.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Short	Likely	2	-24
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

17 ANALYSIS OF ALTERNATIVES

Alternatives are the different ways in which the project can be executed to ultimately achieve its objectives. Examples could include carrying out a different type of action, choosing an alternative location or adopting a different technology or design for the project. By conducting the comparative analysis, the BPEOs can be selected with technical and environmental justification.

Münster (2005) defines BPEO as the alternative that "provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term".

17.1 No-Go Alternative

As standard practice and to satisfy regulatory requirements, the option of not proceeding with the project is included in the evaluation of the alternatives.

The 'no-go' alternative is not supported due to the need for adequate stormwater and sewer infrastructure in order for the Umhlanga Ridgeside Development to function. This will place immense pressure to tie into existing structures which do not have the capacity for more

developments in the area, which has health and environmental impacts if leaks or bursts occur. In addition, if no stormwater control measures are put in place, the environmental impacts in the proposed area include erosion and flooding (which includes the forest area).

17.2 Comparative Analysis of Alternatives based on Impact Assessment

17.2.1 Impacts on Environmental Features

Section 14 indicated the preference of the infrastructure alternatives by each Specialist Study. This section summarises the alternatives preference for each environmental feature by the relevant Specialist Studies and by the EAP. **Table 25** represents the environmental features assessed in the impact study by the relevant Specialist Study, where required, as well as the infrastructure alternative that is most preferred due to the least impact on the environment. Each alternative option was ranked in order of preference: 1 being high and 3 being the least preferred.

Table 25: Summary of the Specialists' preferred options

Environmental Feature/Attribute	Sewer Alternatives			Stormwater Alternatives		
	1	2	3	1	2	3
Geology	No preference			No preference		
Terrestrial Ecology	2	3	1	1	3	2
Air Quality	No preference			No preference		
Noise	No preference			No preference		
Aesthetic Quality	No preference			No preference		
Socio-Economic Environment	No preference			No preference		
Transportation	No preference			No preference		
Existing Infrastructure	No preference			No preference		
Historical and Cultural Features	No preference			No preference		
Watercourses	2	3	1	No preference		

It can be seen that Stormwater Alternative 1 and Sewer Alternative 3 are the most preferred as they had the highest ranking and are thus the recommended BPEO as a result of having the overall least impact on the environment.

17.2.2 Impacts on Technical Aspects

Technical criteria consider the cost and ease of both construction and operation for the proposed infrastructure. Below are the pros and cons as well as the summary of the preferred options from a technical perspective.

17.2.2.1 Stormwater Alternatives

Stormwater Alternatives	Pros	Cons
1	• It provides the "safest" engineering solution to convey the runoff through the forest to the existing headwall on the M4 as runoff is contained within the pipe as opposed to an overland system where there is risk of erosion and siltation; • With the necessary upstream stormwater controls in place, the maintenance of the pipeline should be limited; and • The corridor of the pipeline is narrower than the measures required for an overland system.	• Limited disturbance to the forest during the construction works; • Access will be needed to the pipeline for maintenance purposes however the required maintenance should be very limited; and • The pipeline could be damaged in the event of a fire through the forest however this is unlikely with the soil coverage over the pipe.
2	• It does not involve the removal of trees or the disturbances of tree roots through the section of watercourses that runs through the forest; • It sets out to maintain and promote sheet flow conditions where possible; and • No excavations will be required except for the installation of the silt fences and UV resistant sandbags.	• This option is considered a "soft" solution in the conveyance of runoff along the watercourse and will require ongoing inspections, maintenance and interventions until the section of the watercourse is stable; • As a result of the forest canopy, there is no continuous vegetation surface cover through the forest hence surface protection in the form of reno mattresses or hand packed rock in the areas of the watercourse may be required that are susceptible to erosion; and • In the event of a fire through the forest, sandbags are likely to be burnt and damaged.
3	• It does not involve the removal of trees and roots however tree trunks and roots may require protection by the use of the UV resistant sandbags; and • It provides a relatively "safe" engineering solution to convey the runoff through the forest to the existing pipe culverts on the M4 as runoff is contained within the stormwater channel.	• The footprint for the stormwater channel is larger than that of the pipeline; • Although runoff is contained within the stormwater channel, there is a risk of erosion and siltation and will require ongoing inspections, maintenance and interventions until the stormwater channel is stable; and • In the event of a fire through the forest, geofabric, silt fences and sandbags are likely to be burnt and damaged.

17.2.2.2 Sewer Alternatives

Sewer Alternatives	Pros	Cons
1	• Existing sewer will not be affected during construction of the new sewer main; and • Less interaction with, and relocation of existing services.	• Trees and vegetation are impacted upon within the road reserve (importance of trees impacted upon to be determined by the Terrestrial Ecologist). It is to be noted that a few trees dripline has encroached into the road reserve; • Minimal cover over the seer line at box culvert. The sewer pipe is proposed to be constructed over the roof slab of the culvert and backfilled with a concrete cover slab over the pipe for increased protection; • 825m in total of additional sewer pipeline to be maintained by municipality; and • Traffic accommodation and safety during the construction along Armstrong Avenue.
2	• Existing sewer servitude utilised and no net increase in the extent of sewer reticulation to be maintained by the Municipality; • Limited intrusiveness by using pipe cracking/bursting as no new pipe trenches are dug, except for the drill pits at each manhole; • Existing services (apart from the existing sewer) are not impacted upon during the construction through the existing servitude in the forest; and • The option of pipe cracking as compared to normal sewer installation method is more cost effective.	• Traverses through a wetland; • Continued maintenance of servitude by the city to enable access to the line; • Having to accommodate the existing flows by over-pumping of the sewage from one manhole to the next during construction; • Possible disturbance and infringement of the forest foliage during the construction to transport equipment; • From surveys conducted, it is established that the large embankments due to the platform of the company Derivco, increases the challenge of pipe cracking and the use of a TLB; and • Access to the existing sewer and forest via the Derivco site, however Derivco are reluctant for any construction to take place on their boundary.
3	• The existing sewer will not be affected during the construction of the new pipeline; • Less trees impacted upon along the Western side of Armstrong Avenue as opposed to the Easter side. (importance of scattered trees impacted upon to be determined by the terrestrial ecologist);	• Traffic accommodation and safety during the construction along Armstrong Avenue; • Extensive existing services present with the road reserve will need to be protected and relocated where necessary. This could impact on the duration of the contract period and prolong the construction due to approval of reticulation of services;

Sewer Alternatives	Pros	Cons
	• This route is out of the coastal swamp forest area, lessening the impact during construction; and • This option can reroute flows from the Glades Office park and reduce strain on the existing sewer.	• Minimal cover over the sewer reticulation at box culvert. The sewer pipe is proposed to be constructed over the roof slab of the culvert and backfilled with a concrete cover slab over the pipe for increased protection; and • 830m in total of additional sewer pipeline to be maintained by municipality.

In summary, stormwater alternative 1 is the most preferred from a technical point of view because they involve the least maintenance. Stormwater alternative 3 is the second preferred option as the conveyance of runoff can be contained and controlled through the forest as opposed to alternative 2 which requires ongoing monitoring and interventions.

Sewer alternative 2 is the most preferred from a technical point of view because it is the most practical from an engineering perspective as it involves the least interaction with other services as well as replacing and upgrading an existing gravity sewer main. Sewer alternative 3 is the second preferred option however it involves significant interaction with existing services and will increase the extent of the sewer that will need to be maintained by EMM. It should be noted that all sewer alternatives are feasible.

17.3 Best Practicable Environmental Option (BPEO)

Based on the recommendations of the specialists, technical considerations and the comparison of the impacts associated with the alternatives, the following were selected as the BPEO (**Figure 36**):

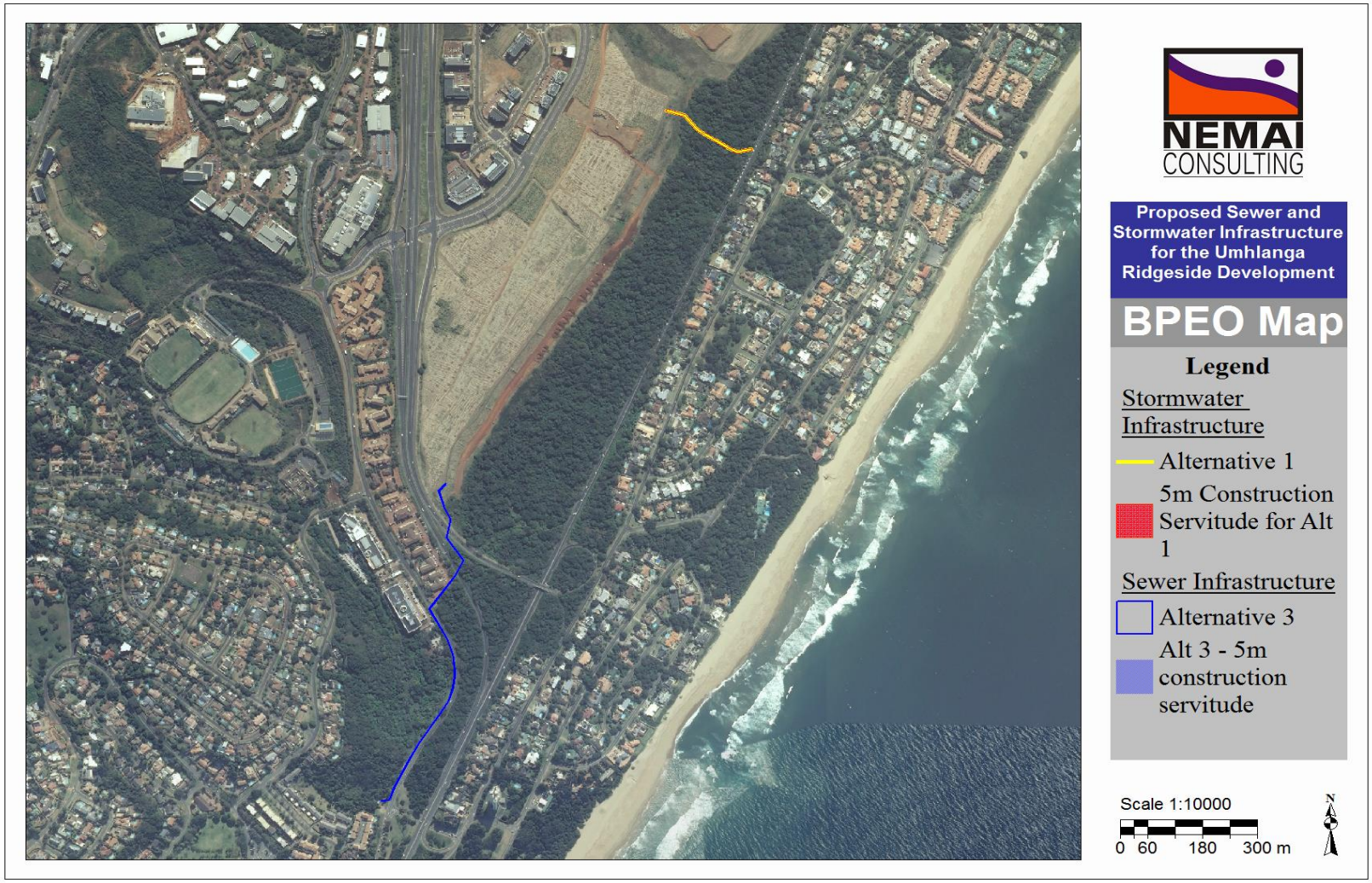


Figure 36: Recommended BPEO

Sewer Alternative 3:

This option follows a similar alignment to Alternative 1 and entails a 250mm diameter sewer pipeline of approximately 830m in length which starts from the boundary of the Glades Office Park, down the western side of Armstrong Avenue, to the Armstrong Avenue sewage pump station. This alignment is adjacent to the existing forest and within the road reserve. A pipe jack will be required across Armstrong Avenue. The proposed construction servitude for this option is 5m wide. Thus, this option entails a footprint of 5m x 830m = 4 150m^2.

Even though sewer alternative 2 was preferred from a technical perspective, this option was highly unfavoured from an ecological and wetland point of view because of the detrimental environmental impacts this option would have (traversing through the forest and the swamp forest wetland). Sewer alternative 3 was selected as the BPEO because it had lesser environmental impacts compared to sewer alternative 1. Sewer alternative 3 also involves less clearance relative to the Listed Activity triggered.

Stormwater Alternative 1:

This option entails a 1200mm diameter reinforced polyethylene stormwater drainage pipe, approximately 215m in length, starting from the stormwater outlet control structure below the lower attenuation pond in Precinct 4 through the forest to end at the existing pipe culverts on the M4. This option traverses through the forest and thus would require a method of installation to reduce as much disturbance as possible to the forest. The proposed alignment was designed to avoid as many trees as possible as well as to limit the depth of excavation so as to limit any damage to tree roots. The proposed reinforced polyethylene material also allows for a less intrusive installation as it requires labour for hand installation (not machinery) and light construction equipment. The proposed construction servitude for this option is 5m wide. Thus, this option entails a footprint of 5m x 215m = 1 075m^2.

Stormwater alternative 1 was selected as the BPEO because it had the overall least environmental impacts compared to stormwater alternatives 2 and 3, and is also most preferred from a technical aspect. Stormwater alternative 1 also involves less clearance relative to the Listed Activity triggered.

18 CONCLUSIONS AND RECOMMENDATIONS

18.1 Sensitive Environmental Features

Within the context of the project area, cognisance must be taken of the following sensitive environmental features, attributes and aspects, for which mitigation measures are included in the BAR and EMPr (**Figures 37** and **38**):

- D'MOSS areas;
- Natural forest (KwaZulu-Natal Dune Forests : East Coast Dune Forest) and recommended 40m buffer;
- Protected tree (*Mimusops caffra*);
- KZN CBA: Irreplaceable Areas;
- Northern Coastal Grasslands terrestrial threatened ecosystem; and
- Swamp forest wetland and recommended 15m buffer.

Figure 37: Sensitivity map for the proposed stormwater infrastructure

Figure 38: Sensitivity map for the proposed sewer infrastructure

18.2 Environmental Impact Statement

In 2007, the Umhlanga Ridgeside Development received EA for a mixed land use development from KZN EDTEA. The approved development consists of residential, commercial, resort and open space development. This development also includes the construction of internal services such as sewage, water and electricity, the construction of stormwater management services, the construction of new roads and intersection, as well as the upgrading of existing roads and intersection. However, the proposed stormwater and sewer infrastructure for the lower portion of Precinct 2 and Precinct 4 did not fall part of the original EA in 2007. The stormwater management plan, approved by eThekwini Metropolitan Municipality (EMM) in 2009 for the Umhlanga Ridgeside Development, included a Stormwater Management Strategy Plan which showed the stormwater connections/routes for the attenuated flows from the Umhlanga Ridgeside Development through the strip of the forest to the existing stormwater reticulation along the M4 motorway. However, details of these connections/routes were not clearly defined and thus were not included as part of the 2007 EA.

Precinct 2 of the Umhlanga Ridgeside Development can be divided into the upper and lower halves. The upper half of the Umhlanga Ridgeside Precinct 2 drains into the existing 750mm diameter bulk sewer main, which reticulates in a northerly direction to the Umhlanga Manors. Sewer reticulation services need to be provided to service the lower portion of Precinct 2 and Precinct 4 of the Umhlanga Ridgeside Development. The sewer infrastructure is proposed to feed into the existing Armstrong Avenue pump station. Three alternative options were considered for the sewer infrastructure.

Stormwater runoff needs to be managed between the Umhlanga Ridgeside Development and the M4 motorway, through the strip of forest, in order to ensure protection of the forest from siltation and pollutants, but to also ensure that the forest is not starved from runoff. Three alternative options were considered for the stormwater infrastructure.

Based on the location and nature of the proposed development, the following environmental specialist studies were conducted:

- Terrestrial Ecological Assessment;
- Heritage Impact Assessment; and
- Wetland Delineation Assessment.

Stormwater alternative 1 and sewer alternative 3 were recommended as the BPEO as they had the least overall environmental impacts.

Critical environmental activities that need to be executed during the project life-cycle include the following:

- Pre-construction Phase
    - Diligent compliance monitoring of the EMPr, EA and other relevant environmental legislation;

  - Permits (if required);
  - On-going consultation with IAPs; and
  - Other activities as per EMPr;
- Construction Phase
  - Diligent compliance monitoring of the EMPr, EA and other relevant environmental legislation;
  - Reinstatement and rehabilitation of construction footprint;
  - On-going consultation with IAPs; and
  - Other activities as per EMPr;
- Operational Phase
  - Routine maintenance and inspections of the infrastructure;
  - Implement erosion, stormwater and pollution control measures; and
  - On-going consultation with IAPs.

With the selection of the BPEO, the adoption of the mitigation measures include in the BAR and the dedicated implementation of the EMPr, it is believed that the significant environmental aspects and impacts associated with this project can be suitably mitigated.

18.3 Recommendations

The following key recommendations, which may also influence the conditions of the EA (where relevant), accompany the BAR for the proposed stormwater and sewer infrastructure for the Umhlanga Ridgeside Development:

1. Where relevant, the construction domain needs to be contained within the site footprint as much as possible to avoid disturbance outside of the project footprint.
2. As discussed in the EMPr, various forms of monitoring are required to ensure that the receiving environment is suitably safeguarded against the identified potential impacts, and to ensure that the environmental management requirements are adequately implemented and adhered to during the execution of the project. The types of monitoring to be undertaken include:
    a. Baseline Monitoring needs to be undertaken to determine to the pre-construction state of the receiving environment, and serves as a reference to measure the residual impacts of the project by evaluating the deviation from the baseline conditions and the associated significance of the adverse effects;
    b. Environmental Monitoring entails checking, at pre-determined frequencies, whether thresholds and baseline values for certain environmental parameters are being exceeded; and
    c. Compliance Monitoring for the Independent ECO to monitor compliance against the EMPr and EA.
3. Pertinent recommendations from the Terrestrial Ecological Impact Assessment (**Appendix 7A**) include:

a. The protected tree species, *Mimusops caffra*, should be avoided by shifting the recommended sewer alternative 3 within the required servitude. If this is not possible, then a permit for either removing, destroying or disturbing this plant must be acquired from DAFF before any construction commences. In order to reduce the impacts on the protected tree within the critically endangered forest, the Applicant should purchase at least 10 medium to large sized *Mimusops caffra* on removal of the existing Coast Red Milkwood, and plant on the property as part of landscaping.
b. The proposed infrastructure alternatives are located within or adjacent to a natural forest areas and DAFF prohibits the cutting, disturbance, destruction or removal of any indigenous living or dead tree in a forest without a licence. In terms of Land Use Guidance from Threat Status of Forests, no activities or development must be considered that will destroy forest and only low-impact eco-tourist facilities like boardwalks and bird-hides, but no buildings, infrastructure or bush camps in a critically endangered forest type. The edges of the forest areas are dominated by alien invasive plants species and no plant species of conservation concern were recorded on site. During the 2009 EIA process, a 40m buffer was recommended by the eThekwini EPCPD in order to protect the forest, however there is no other site option available for the stormwater infrastructure placement. The aim of the stormwater management is to protect the watercourse from the harms of the uncontrolled stormwater runoff to the natural forest, so as to enhance the watercourse downstream by intercepting the silt and pollutants and also retarding flows. In order to protect the forest from siltation as well as to mimic sheetflow conditions such that the forest is not starved of runoff, a swale has been constructed directly above the forest. Construction activities within the proposed 5m construction servitude for the recommended stormwater alternative 1 should be mimimised as far as possible with consideration of the forest area.
c. The disturbance and or clearing of vegetation must be limited only to areas of construction and the construction footprint must be limited to the absolute minimum required. All excavation must be done by hand in order to minimise the impacts on the forest as the severe impacts on the forest could lead to long-term damage to the environment. After the construction activities, there should be no permanent scar remaining and minimal or no forest fragmentation. All recommended mitigation measures must be included in the EMPr. The Forest Management and Restoration Report compiled by Newtown landscape Architects cc was considered when recommending mitigation measures for inclusion in the EMPr.

4. Pertinent recommendations from the Heritage Impact Assessment (**Appendix 7B**) include:

a. Should any chance finds of heritage sites and/or objects be located or observed during construction, a heritage specialist must immediately be contacted and the General Management guidelines in the study must be adhered to.

5. Pertinent recommendations from the Wetland Delineation Impact Assessment (**Appendix 7C**) include:
    a. To protect the freshwater ecosystems from impacts linked to the construction and operational phases, appropriate buffer zones should be adopted. The approved buffer zones for the study site includes a 15m buffer for the areas upstream of the swamp forest wetland and a 15m buffer for the area downstream of the wetland.
    b. Adhere to the general recommendations for the pipeline construction phase (included in section 8.2.2 of the study which have also been included into the EMPr) such as construction vehicle operation, excavation, trenching, backfilling, re-vegetation and erosion control, and completion of construction activities and rehabilitation.
    c. It is imperative that the implemented pipeline infrastructure is regularly monitored for leaks and/or signs of damage. Maintenance of sewage and stormwater manholes should occur on a regular basis in order to ensure the longevity and the overall effective operation of the pipeline infrastructure.

19 OATH OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

I (name and surname) _____

Of (address) _____

ID No. _____ *Contact No.* _____

I hereby make an oath and state that:

In accordance with Appendix 1 of Government Notice No. R. 982 of the amended 2014 EIA Regulations (07 April 2017), this serves as an affirmation by the Environmental Assessment Practitioner (EAP) in relation to:

Section 1(j) -

1. *The correctness of the information provided in this report(s);*
2. *The inclusion of comments and inputs from stakeholders and interested and affected parties;*
3. *The inclusion of inputs and recommendations from the specialist reports where relevant; and*
4. *Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties.*

Section 1(k) -

The level of agreement between the EAP and interested and affected parties on the plan of study for undertaking the environmental impact assessment.

1. I know and understand the contents of this declaration.

2. I do not have any objection in taking prescribed oath.

3. I consider the prescribed oath to be binding on my conscience.

Signature _____*Date:* _____

I certify that the deponent has acknowledged that he/she knows and understands the contents of the statement and the deponent signature was placed there on in my presence.

COMMISSIONER OF OATH	FULL NAME	DESIGNATION